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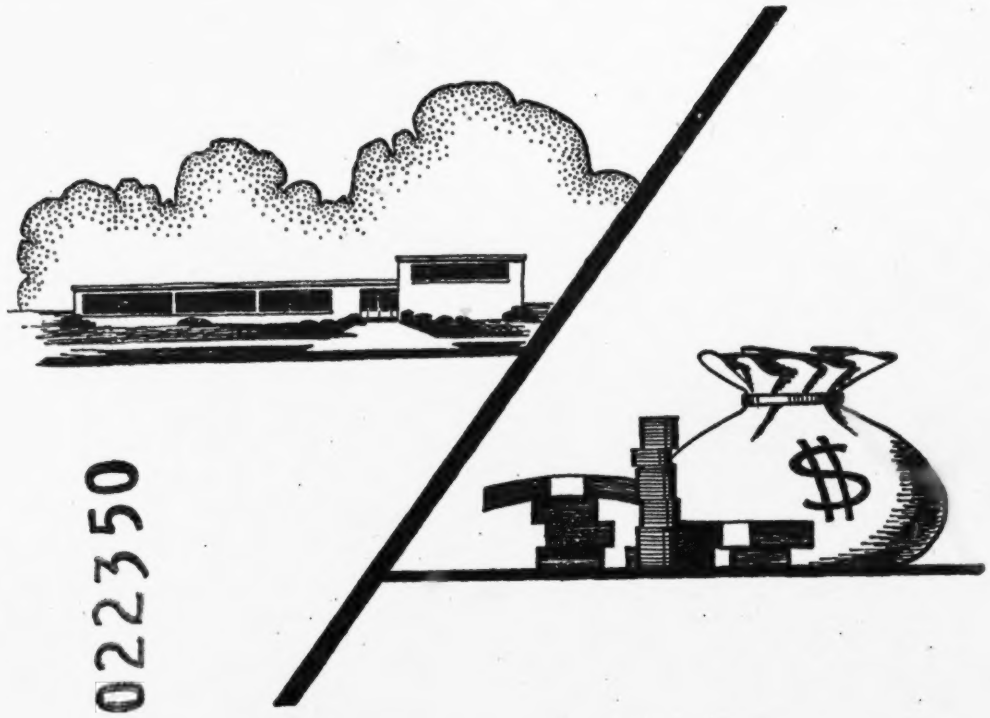
Topics of economical designing and planning are examined in both general and specific terms. Diagrams and photographs illustrate general conditions and principles while the text outlines criteria and provides specific suggestion. Subjects covered include--(1) building design fundamentals, (2) cost comparisons, (3) efficient design, (4) basic plan schemes, (5) environmental control factors, (6) element planning, (7) site accommodation, (8) expansion facilitation, (9) trend development, and (10) state and local codes. A bibliography is included. (MH)

DESIGNING THE SCHOOL PLANT FOR ECONOMY



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THE SCHOOL BUILDING

ECONOMY SERIES 4

STATE DEPARTMENT OF EDUCATION
HARTFORD, CONNECTICUT
JUNE, 1961

DESIGNING

THE SCHOOL PLANT

FOR ECONOMY

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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INTRODUCTION

When an astute man sets out to build a house, he first determines as best he can what his family's needs will be in the years to come. He considers his growing children and their changing needs. He ponders the possibility that aging parents may later make their homes with him. He realizes the rapidity with which new household gadgets become everyday necessities. He begins to realize that for the future happiness of his family, as well as their financial security, it behooves him to find out all he can about the design of houses, the latest trends in family living patterns, the outlook for technological advances and the probable costs of various space and features.

At the same time he concerns himself with the present and future cost of his undertaking. He will review his present and anticipated income, current costs for operating the household, other future expenditures, and allow a prudent sum for contingencies. He will endeavor to secure the most for his money. In short, he will become as well informed as he possibly can about what he and his family would like to have and their expected ability to pay for it. Only then is he properly prepared to direct his architect in the design, so as to develop a scheme that will give him and his family as many of the features desired as his resources will safely permit.

So, too, with the school building committee member. He suddenly finds himself a part of a group made responsible for a major community undertaking, accompanied by the expenditure of large sums of his townsmen's money. Quite naturally, he feels a keen need for all possible information on the entire subject of school building, so that his community will receive the greatest possible value for its school dollar and so that he will acquit himself honorably of this public trust.

The SCHOOL ECONOMY SERIES, of which this booklet is one, proposes to furnish, in compact form, the basic information needed by school building committee members in their efforts to produce economical school plants – that is, schools that will do the best educational job over an extended period of time with the least drain on the community's resources.

This particular booklet addresses itself to the overall design of school buildings. Designing the school plant in accordance with the educational specifications provided is the architect's prime function; there is no intent here to submerge his importance in the slightest degree. Rather, the purpose of this publication is to enlarge the layman's understanding of the problems faced by the architect, so that his efforts can be directed by the school building committee more confidently and efficiently toward their common goal – the best possible educational plant for the least possible cost during its useful life.

Richard L. Howland, Architect
School Construction Economy Service

CHAPTER I

THE APPROACH TO SCHOOL BUILDING DESIGN

A. EDUCATIONAL SPECIFICATIONS

It seems safe to say that the most serious waste of public school funds can occur through the mistaken construction of a plant which contains facilities which are not needed, or omits those which are necessary.

Architectural planning entered into hastily, without suitable detailed consideration of the purposes to which the intended plant will be put, promotes this insidious form of waste.

The deliberative process and statement of the problem is generally called "programming." In school plant planning the term "educational specifications" is used to indicate the document which sets down the main considerations and conclusions reached during this critical planning operation.

A good educational specification is the foundation of a successful school building design. An educational specification contains an outline of the program of education intended for the pupils who will use the school, lists other community activities that the plant may have to accommodate, and lists the facilities presumed necessary to carry out these objectives. The detailed development of educational specifications is to be the subject of a separate booklet in this Series.

1. Producing an educational specification is ordinarily the responsibility of the local administrative staff, unless an outside consultant has been engaged to perform this task, subject to the policies and approval of the local board of education.

B. THE ARCHITECT

The architect must then take this statement of the problem he is to solve and proceed imaginatively to plan a structure and grounds which will effectively house the various activities envisioned. The results of his work should not merely permit but should actively encourage and assist in achieving the results desired. This requires of him both an understanding of the educative processes and a great deal of cooperation with the local educational staff.

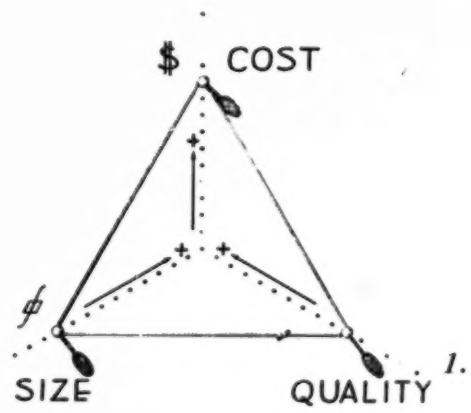
The architect, in designing a school plant, is subject to many pressures; his work involves the reconciliation of myriad needs, desires, and limitations, many incompatible, but all related and affecting each other. It is essential that he provide for as many of the following requirements as possible without undue compromise with the many limitations:

Requirements:		*Limitations:*
Educational functions		Occupancy deadlines
Community utility		Available funds
Physical safety		Available utilities
Environmental comfort	Design	Character of the site
Efficient space use	Problem	Physical hazards
Convenience in use		Codes, legal restrictions
Minimal maintenance		Climate and micro-climate
Aesthetic excellence		Materials and methods
Provisions for change		Prejudice and custom

The development of a satisfactory architectural solution to a school plant design problem involves most of the above considerations simultaneously, at each stage of its progress from early thumb-nail sketches through the basic (preliminary) drawings.

C. ECONOMIC FUNDAMENTALS

Ignoring, for the moment, efficiency of space utilization, the three economic fundamentals, cost, size and quality, react upon one another in much the manner shown in the following diagram of a taut string about three movable pegs:



1.

As may easily be seen, if the string is to be kept taut, an increase in size or quality results in added cost; a reduction of cost forces an appropriate reduction in either size or quality, and so forth.

From this it should be clear that the architect should not be expected to design a project to a predetermined size and quality for a specific cost. Two of the factors can be predetermined, but he must have some freedom to adjust at least one of them to the others.

However, the foregoing applies primarily to initial cost, that is, the cost of construction. Often overlooked, the later and continuing costs of operation, maintenance and repairs are of an importance deserving very careful scrutiny during the design stages.

Anything that can be designed into a plant which saves work on the part of the paid staff, reduces the consumption of fuel and power, or minimizes the needs for refinishing and repairs will pay dividends to the community for the entire useful life of the plant.

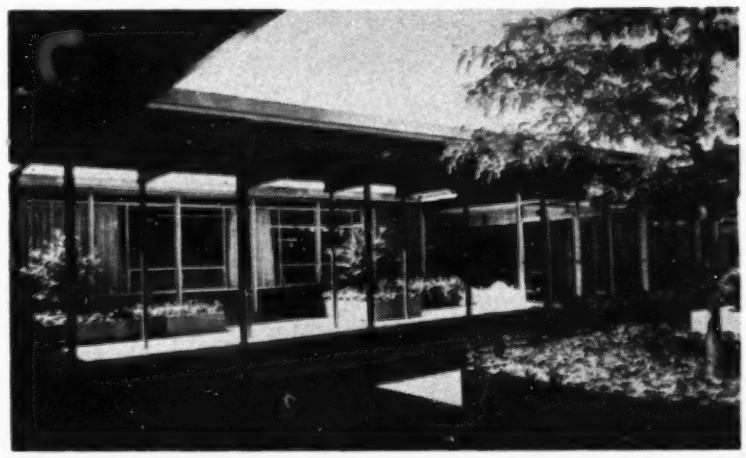
Hence, materials and finishes should not be chosen on the basis of low first cost alone, but rather for lowest overall cost. In some of the larger systems, particularly in cities, rather careful accounts are kept of the costs of operation, maintenance and repairs. It is no accident that such systems are also those which insist most strongly on the use of durable, high-quality materials and finishes; experience has shown that long-range economy is gained thereby.

D. ARCHITECTURAL CHARACTER

While organizing all the many elements and details of a school plant into an efficiently functioning entity, the architect is also infusing it with a rather indefinable quality called "character".

Aesthetic qualities, such as logical and satisfying form, appropriate and interesting color and texture, pleasing decoration, and good scale (suitable size of elements as related to function all combine to make the intangible "architectural character".

Note should be taken, too, of the fact that these principal ingredients of architectural character, that is, form, scale, color, texture, and imagination, are provided by the architect at little or no additional cost; the degree to which that character is good is a measure of the architect's genius.



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CHAPTER II

COST COMPARISONS AND THEIR PITFALLS

A number of states, including Connecticut, publish statistical data on public school building projects. Likewise, nationally circulated architectural and educational periodicals and manufacturers' literature provide cost and other data on school construction operations.

Practically every new school plant project is subjected to comparisons with others already built or in the planning stage. Many persons, in making such comparisons, overlook the facts that such schools have been built at different times and places, of various materials and by different methods, under various regulations, and often for differing purposes.

To further confound such comparisons, reported costs vary in what they include, area computation methods vary and pupil capacity formulas differ from place to place and with differing purposes.

The three most common criteria used in typical comparisons are:

Cost per square foot ..... ($/s.f.)

Cost per pupil ..... ($/pupil)

Area per pupil ..... (s.f./pupil)

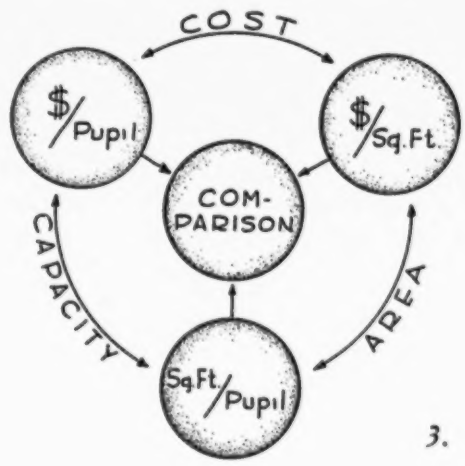
These three criteria are the result of interaction among three *basic* factors in any school building project:

COST ..... (in dollars)

AREA ..... (in square feet)

CAPACITY ..... (number of pupils accomodated)

The relations of these factors and the resulting criteria used in common comparisons is diagrammed in the following illustration:



3.

These basic factors must all be computed; no comparisons of different schools can be valid unless these factors are *computed in the same way in each case, and adjustments made* for variations in certain qualitative factors. The usual points of variance among these three basic factors are outlined as follows:

COST:	*AREA:*	*CAPACITY:*
Method of computation	Method of computation	Method of computation
Qualitative factors:	Qualitative factors:	Qualitative factors:
Materials	Design efficiency	Educational factors:
Methods	Code mandates	Organizational pattern
Design efficiency		Utilization
Code mandates		Code mandates
Time:		
Economic conditions		
Labor market		
Place:		
Climate		
Site		
Economic conditions		
Labor market		

Within each state, such as Connecticut, the areas and capacities of all schools reported upon by the State Department of Education are consistently computed by established methods. Reported costs for "building only" will vary somewhat according to what equipment has been included. These costs will by no means clearly reflect such important matters as the kinds of facilities provided, materials and methods used, or market conditions at the time of bidding. Further, these comparisons pertain to initial costs only, and give no indication of relative operating or maintenance costs.

Clearly then, *absolutely valid* comparisons are difficult to accomplish even within one state, and much more so across state borders.

However, the foregoing does not signify that comparisons are useless or necessarily misleading. Rather, it is intended to point out that such comparisons must be made with full realization of their limitations, and that conclusions based upon them must be reached only after the exercise of due care, if false results are to be avoided.

CHAPTER III

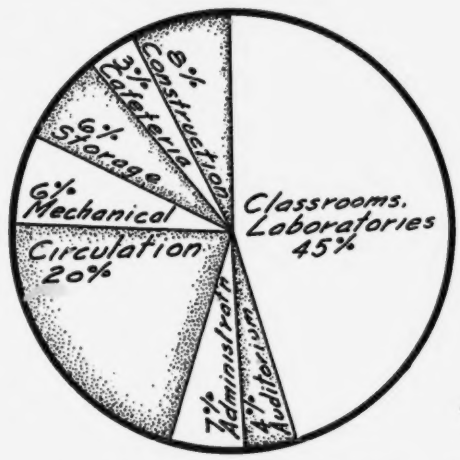
INCREASING EFFICIENCY

A. SPACE UTILIZATION

All buildings enclose space; unnecessary and non-productive spaces are just as costly to build, operate and maintain as productive spaces.

Directly productive spaces may be defined as those in which the required functions of the building take place. In the case of a school this function is primarily education. Non-productive spaces, such as administration, food service, corridors, toilets, storage, service spaces and so forth are all essential to carrying out this primary purpose. However, they should be kept at a practical minimum, consistent with achieving the primary objective of a good educational program.

The average space allocations for a group of high schools, for example, were as shown in the following diagram:



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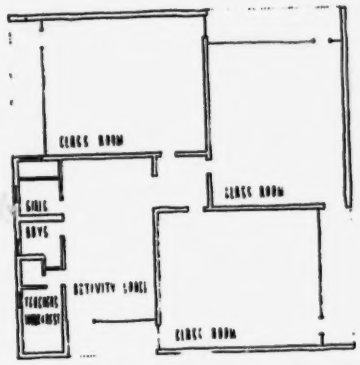
1. *Circulation* spaces such as corridors, passages, stairways, lobbies and entrances are obvious necessities, but ordinarily do very little to further the educational program. Hence maximum economy dictates that either of two courses be pursued.

a. *Utilization* for educational purposes, so as to perform the function of some required educational space.



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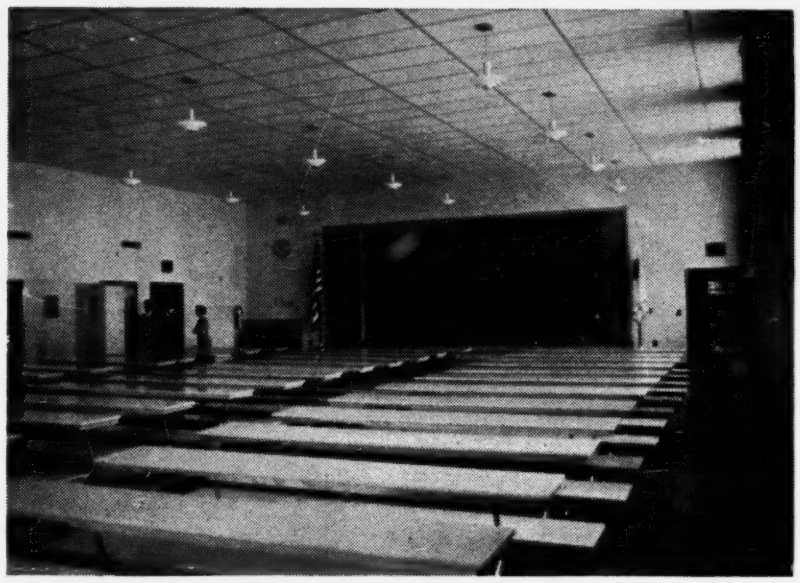
b. *Reduction* by optimum compactness of plan, minimal dimensions, or a maximum of outdoor circulation.

2. *Community-Use* facilities are frequently very desirable, and from a community point of view, they may present an economical solution to a local problem. However, in many cases such facilities add substantially to the cost of the school project and to its maintenance and operation, while contributing little or nothing to the educational program. Examples might include extra public toilets and coat rooms, large spectator spaces for exhibition games, special facilities for visiting and varsity teams, separate kitchens for evening gatherings, extra-large auditoriums, elaborate stage equipment and the like. Local officials should constantly bear in mind that any costs for constructing, operating and maintaining such facilities should not, in fairness, be thought of as part of the community's "cost of education".

3. *Combination* facilities often prove economical in specific cases. Idle spaces, resulting from inability to fully schedule their use, should be carefully considered in this connection. Large cafeteria dining spaces, if used only for this purpose, stand idle much of the average school day and consequently are not easy to justify from an economic point of view. In smaller schools, special-purpose areas such as shops, laboratories, auditoriums and the like, may often have a large number of periods per week when they do not perform their specialized function. Where this occurs, consideration should be given to the design of multiple-purpose facilities. Where truly appropriate, the multiple use of certain school spaces increases efficiency to a high degree, with corresponding economy. Caution, however, is required so as to avoid *false economies* resulting from impractical combination uses in specific situations. Many combinations will require detailed and imaginative analysis of the various uses and class scheduling before a sound decision can be reached. Some of the more common combination facilities are the following:

a. *Auditorium-Cafeteria* – This combination has the advantage that for at least some auditorium functions, furniture does not require rehandling,



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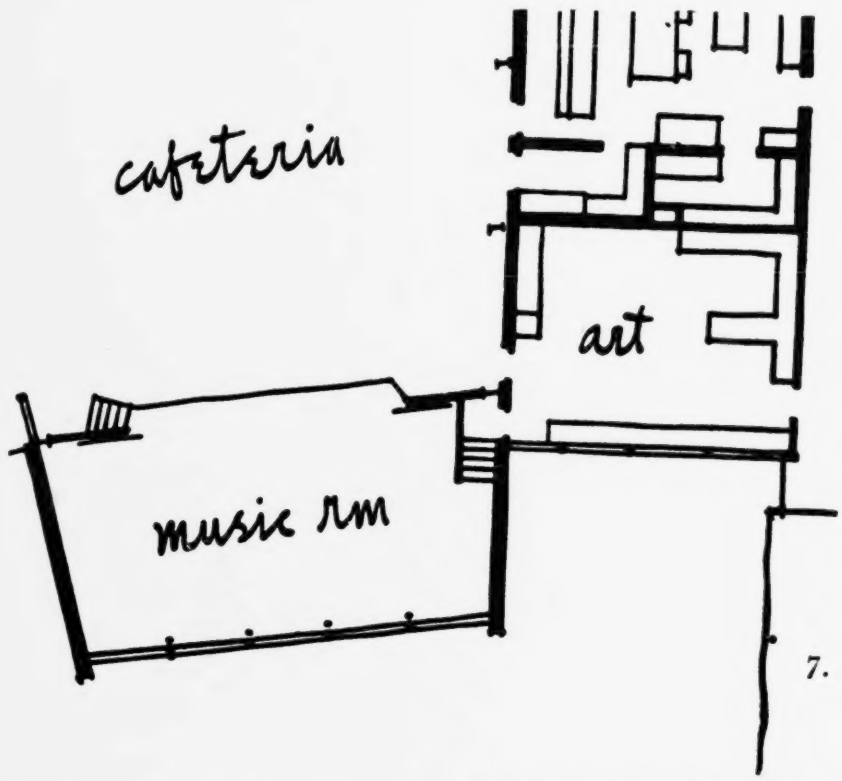
and in any case the chairs can remain. However, in larger sizes, sight-line difficulties and acoustical problems occur. In addition, kitchen noise and odors may interfere with stage or platform presentations unless well controlled.

b. *Cafeteria-Special Purpose* — There have been a few cases where a cafeteria, outside dining hours, has been used for special purposes, such as cooking, a sewing laboratory for an adjacent homemaking department, a reading room for an adjacent library, for vocal or instrumental music, or by subdividing with folding partitions into one or more separate rooms for academic or small-enrollment classes, various student activities, or administrative uses. This trend seems entirely logical, where careful scheduling demonstrates practicality, and it deserves consideration in the planning of many school plants.

c. *Stage-Music Room* — Since musicians frequently perform on stage, and the stage is often unused, this combination is occasionally resorted to. Its disadvantage, of course, is the "tying up" of the auditorium during such use, unless special provisions are made to avoid such interference. An additional problem requiring satisfactory solution is the need for storing and additional handling of instruments, stands, music, uniforms, and orchestra steps. The location of the stage in relation to other spaces becomes increasingly important under such conditions.



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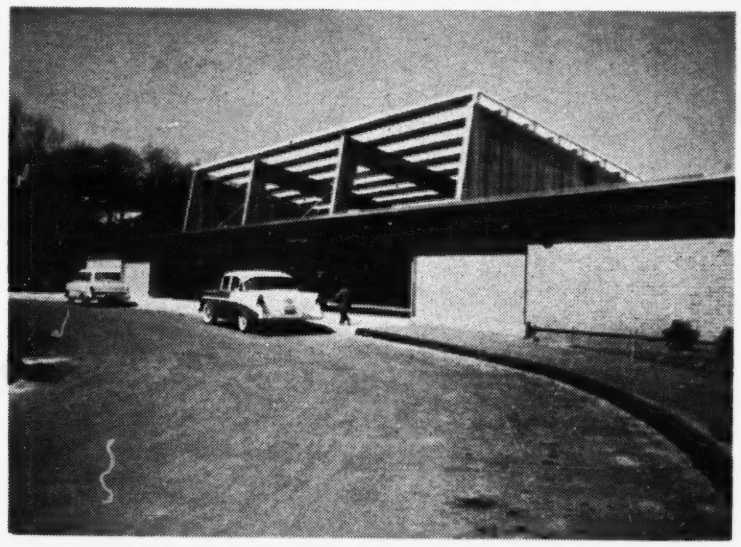
d. *Outdoor Gym-Bus Loading Area* — An occasional elementary school has made very successful use of this very economical combination. It provides a quite adequate gymnasium facility for most elementary physical education activities at a substantially lowered cost, provides excellent bus-

loading space, and also permits after school use by the children and youth of the neighborhood without opening the building, if such use does not present supervision problems.



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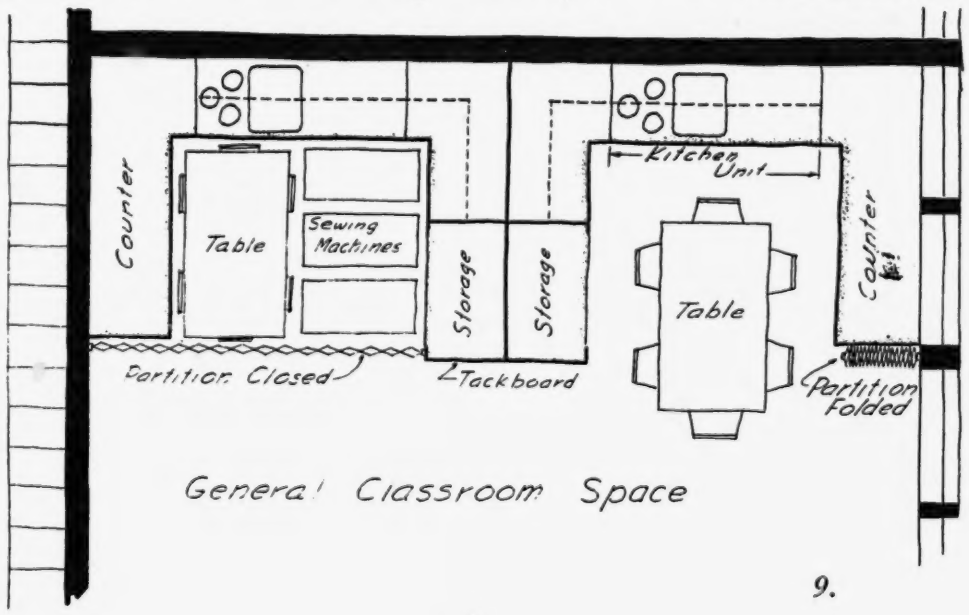
e. *Classroom-Laboratory* — In some cases, usually small high schools, where the number of participants makes separate special-purpose rooms difficult to justify on an economic basis, a simple combination may provide a satisfactory solution. For example, a regular classroom may be somewhat enlarged to provide space which, when opened to the main room, provides the working equipment for a modest shop, homemaking laboratory, science laboratory, and so on, utilizing the main room for space into which these special activities may expand. Likewise, special-purpose shops and laboratories can be designed with some additional space and suitable seating arrangements so that when not in use for their special purpose, they may double for small classes which require a minimum of fixed, specialized equipment. The following sketch illustrates this principle as applied to a part-tme homemaking laboratory combined with a classroom:



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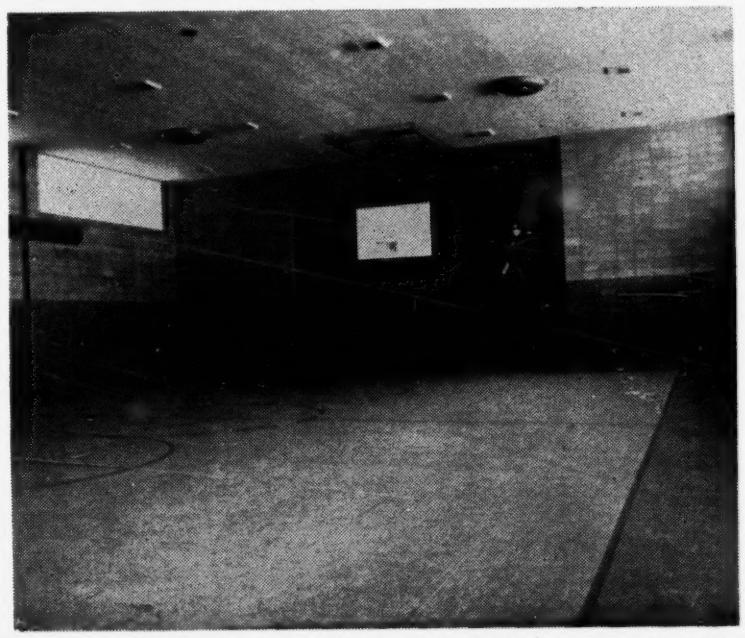
f. *Gymnasium-Auditorium* — This is one of the most common and frequently the poorest of combination facilities, especially in the larger sizes. It usually results in an adequate but not ideal gymnasium, but its faults as an auditorium include poor sight lines due to flat floor, poor acoustical conditions due to parallel hard surfaces, darkening problems with drapery costs, and maintenance costs due to the need for much handling of loose chairs.



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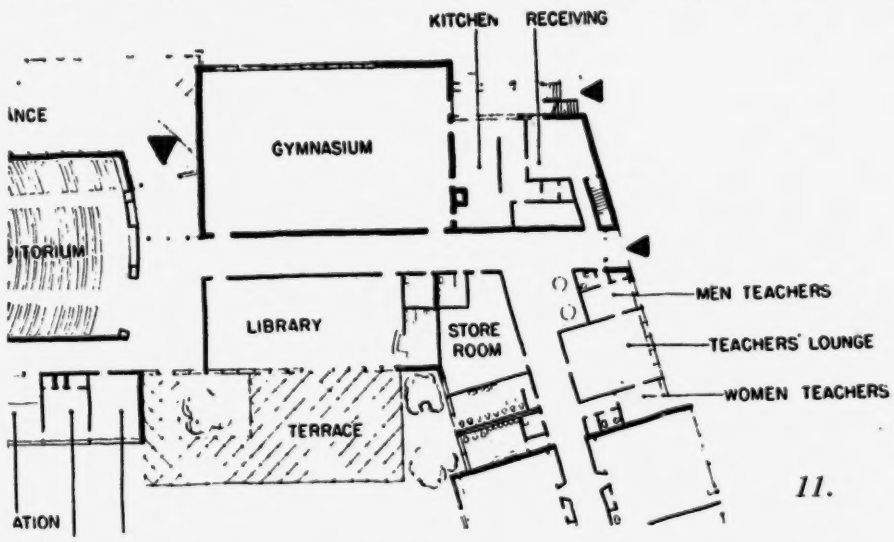
g. *Gymnasium-Cafeteria* — Usually decided upon to justify a separate auditorium, this seldom-used combination has the following disadvantages:

1. Gym flooring is usually incompatible with food spillage and daily furniture moving.
2. Aesthetically it is seldom satisfactory for dining, due to lack of view, visually unattractive interiors and unappetizing odors.
3. Twice-daily moving of furniture, unless more expensive in-wall type



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tables and benches are used; otherwise extensive space must be devoted to storage of tables and chairs.

h. *Multi-Purpose Room* — Is frequently successful in the smaller elementary schools. Here the space is used for cafeteria dining, auditorium on occasion, and as a gymnasium. Careful analysis of expected use should be made prior to determining upon this combination, to make sure that time will actually be available to schedule the space for the several uses intended.

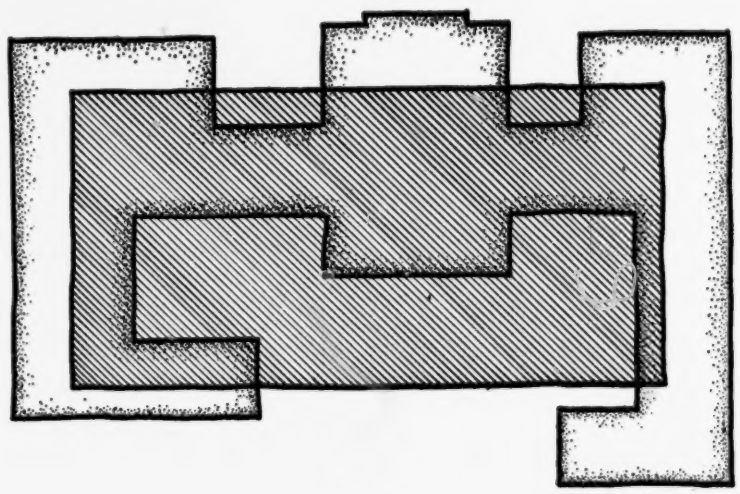
4. *Unnecessary Basement Areas* — On some occasions committees have demanded substantial amounts of unfinished basement area, on the apparent theory that such space is cheap to build. There is no question that such spaces cost less to build than finished spaces above ground. On the other hand, no space at all is more economical than the cheapest space which is not needed. Unless there is clearly defined need for such areas, it is not economical to construct them.

5. *Pipe Tunnels and Crawl Spaces* — These spaces are not usually included in computations of total project area. But their price is inevitably included somewhere in the total project cost. Wherever practical they should be eliminated in favor of methods requiring the construction of little or no additional space for the running of and access to utility lines.

B. INEFFICIENCIES TO BE AVOIDED

1. *External Surfacing*

a. *Perimeter* surface reduction involves surrounding a given amount of area with the least amount of exterior covering material. This calls, in turn, for compaction and avoidance of unnecessary jogs and changes of direction, with their attendant and costly corners, as well as the elimination of height not needed. Following are superimposed two extreme examples illustrating the basic difference:



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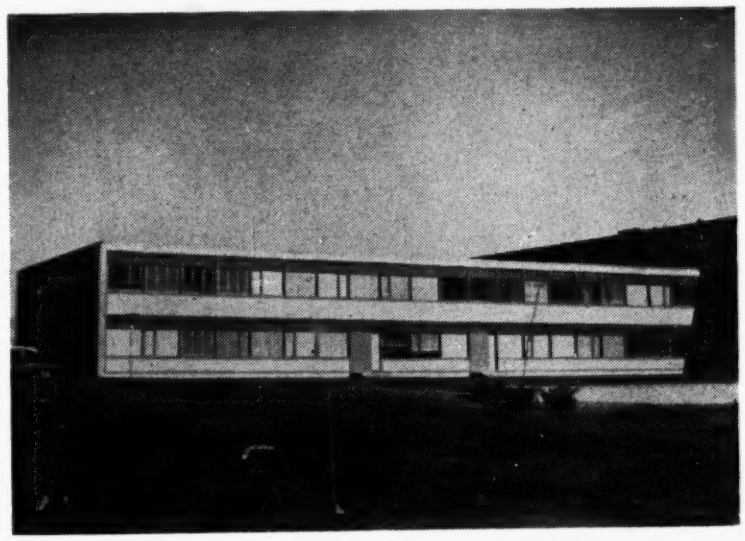
b. *Roofs and Overhangs* — These likewise have their cost. Flat roofs require less material to shelter a given area than do sloping roofs, and overhangs should be reduced to the least projection consistent with their proper function.

2. *Lack of Uniformity*

Repetition in the use of various components, such as structural members and windows, simplifies construction in many ways, resulting in lowered costs. In the design stage, the adoption of a "planning module" paves the way to economical basic uniformity. The planning "module" is a sort of imaginary building block of which the entire structure is composed. Its dimensions are determined for the particular project, but consistent in general throughout, permitting repetition of a great many conditions.

Also highly recommended is the system of planning and dimensioning called "Modular Measure". This is based upon relating all dimensions to an imaginary three-dimensional grid of lines four inches apart. This system has been developed and promoted by eminent organizations in the building industry for increased efficiency in both design and construction. Factual testimony as well as theory seems to demonstrate that its use will result in increased economy.



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CHAPTER IV

BASIC PLAN SCHEMES

Frequently the question is raised, "What is the best plan for schools?" The fact is, there is no "best plan" for all schools. There may be a "best plan" for a particular school, but more than likely there will be several excellent ways of solving each problem.

There has been much experimenting done and study given to school building design, particularly during the years since World War II, with the very substantial result that unit costs of school buildings have risen less than any other major category in the building industry, and less than most other things we buy, for that matter.

Despite all this, there is no "standard" arrangement for the general layout of school buildings. This situation reflects natural differences in regional and local climates and materials, site conditions, code restrictions, educational methods and community purposes, as well as healthy difference of opinion among architects, who are consistently striving for improvements in design and construction.

As a result, the new building committee member may find himself faced with what seems a bewildering variety of types and claims concerning them.

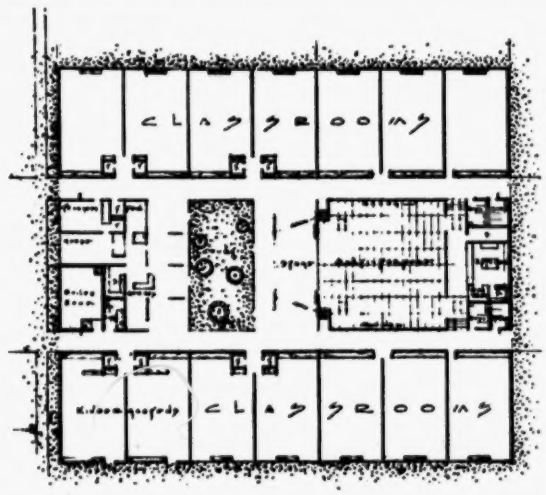
A. PLAN ARRANGEMENTS

While there seems to be an infinite variety of schemes and variations upon them, most layouts can be separated, at least loosely, into the following basic categories:

Very Compact	Cluster Plan
Moderately Compact	Campus Plan
Finger Plan	Combinations

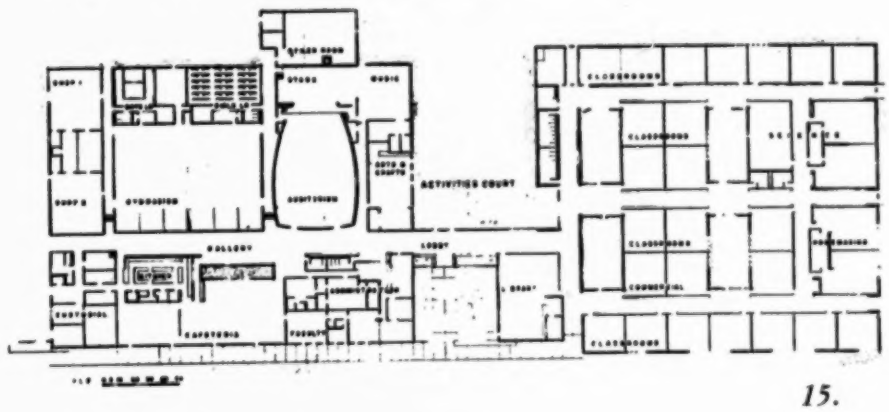
1. *Very Compact*

A good compact plan, relatively easy to accomplish in the smaller school, is characterized by a minimum of exterior surface, so as to enclose the necessary space with the least amount of exterior materials. Concurrent advantages are relatively short corridors, utility lines and travel distances.



14.

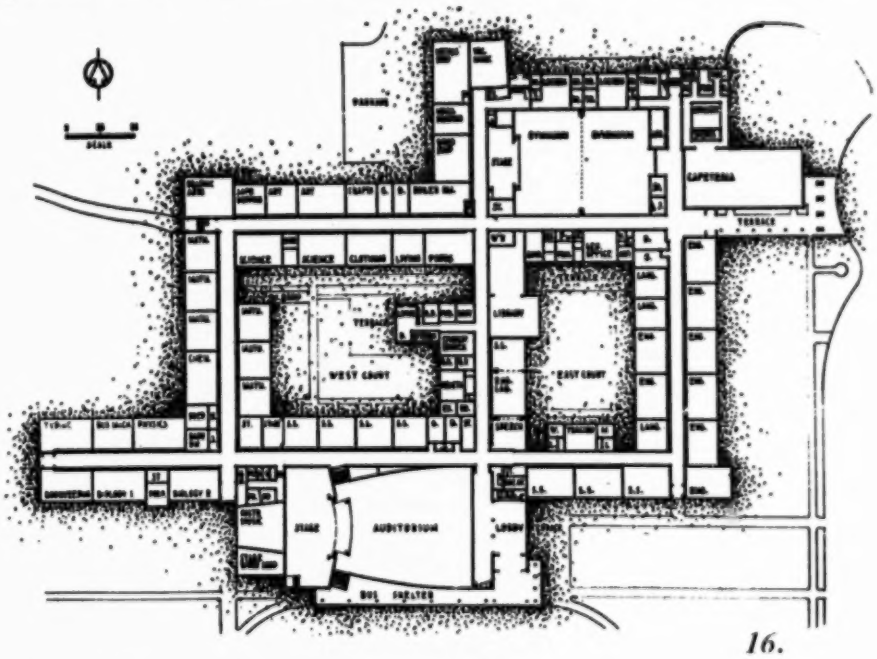
As size increases, however, more and more space is farther and farther from windows and the natural lighting and ventilation they provide. This eventually forces the introduction of interior courts or dependence upon artificial lighting, mechanical ventilation, and often mechanical cooling.



15.

2. *Moderately Compact*

It seems likely that the majority of current schools would fall into this classification. The moderately compact plant usually results from a compromise between the desire for maximum compactness and the desire for daylighting, simpler window ventilation and aesthetic considerations. Often it consists of a core of common-use facilities with more or less stubby wings in various directions, housing classrooms and various special-purpose occupancies. The prevalence of this arrangement for medium-sized plants seems to indicate widespread conviction regarding its merits.

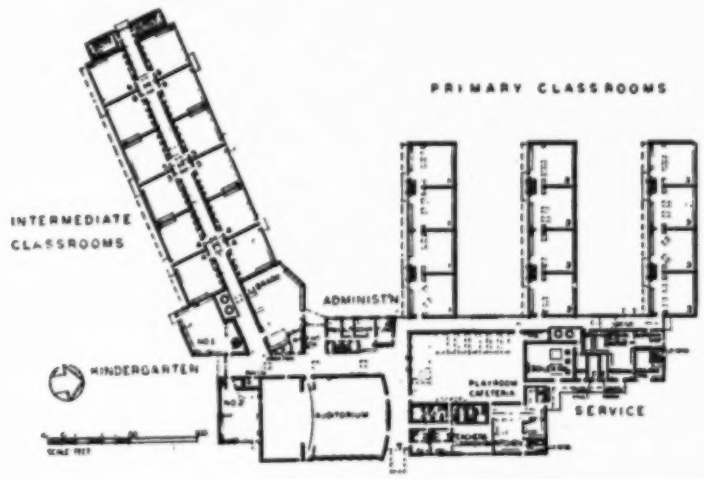


16.

3. *Finger Plan*

This arrangement, an offshoot of the moderately compact scheme, characteristically has longer and usually parallel wings attached to a common-

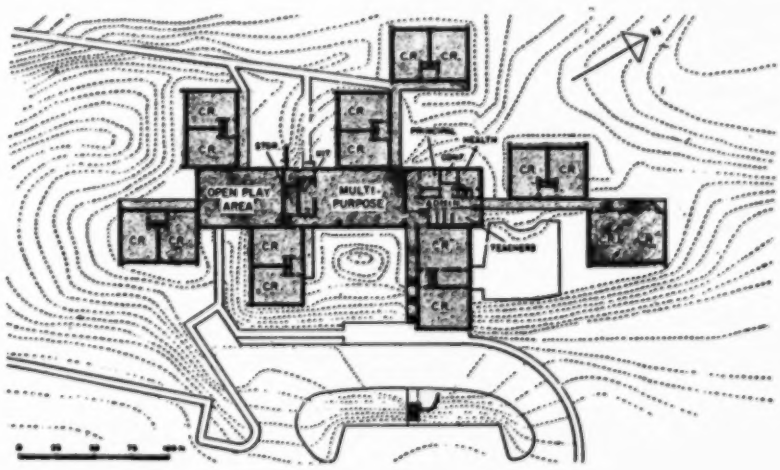
use core. Its early prevalence in California suggests that motivating factors in its use are the desires for cross-ventilation and suitable orientation to control daylight properly, as well as to minimize sun-glare and heat input. It has obviously a higher percentage of exterior surfacing for the space enclosed, and, other things being equal, might be expected to have a higher heat-loss with correspondingly greater fuel consumption, as well as greater initial cost than a compact scheme. It is at its best in situations where outdoor "corridors" are appropriate and acceptable.



17.

4. *Cluster Plan*

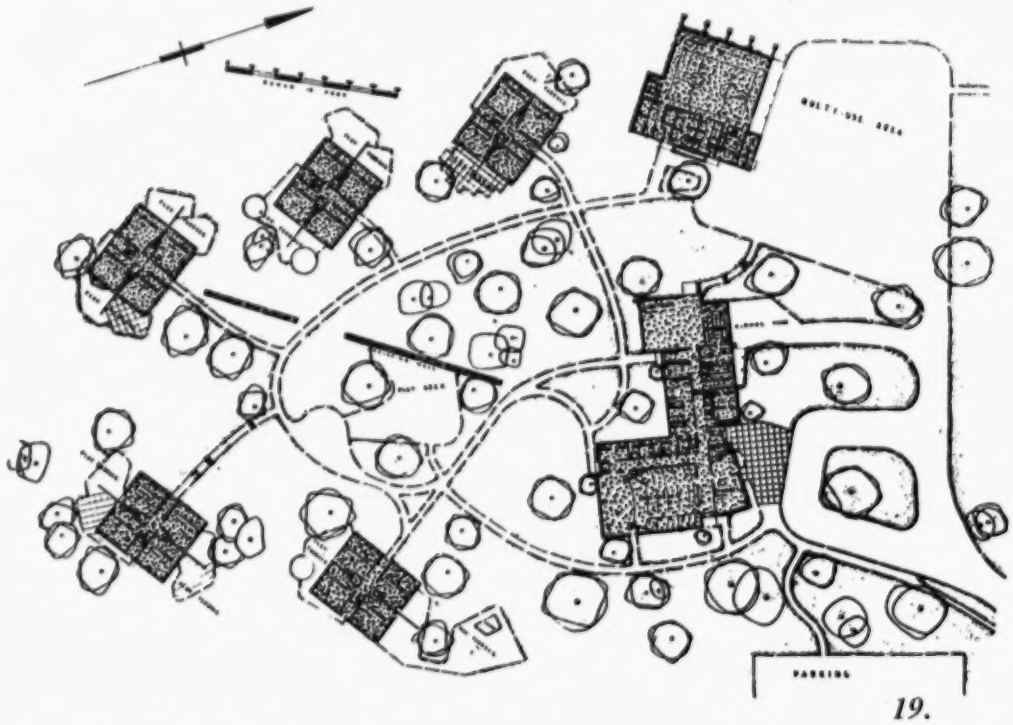
This scheme bears some resemblance to the finger plan, but instead of slender wings, more compact structures are grouped about and attached to a core structure. These may be identical units of classrooms in an elementary school, or, in a secondary plant, subject department units, team teaching units, and so forth. This arrangement is ordinarily more compact than the finger plan, permits greater flexibility, and may considerably reduce corridor space.



18.

5. *Campus Plan*

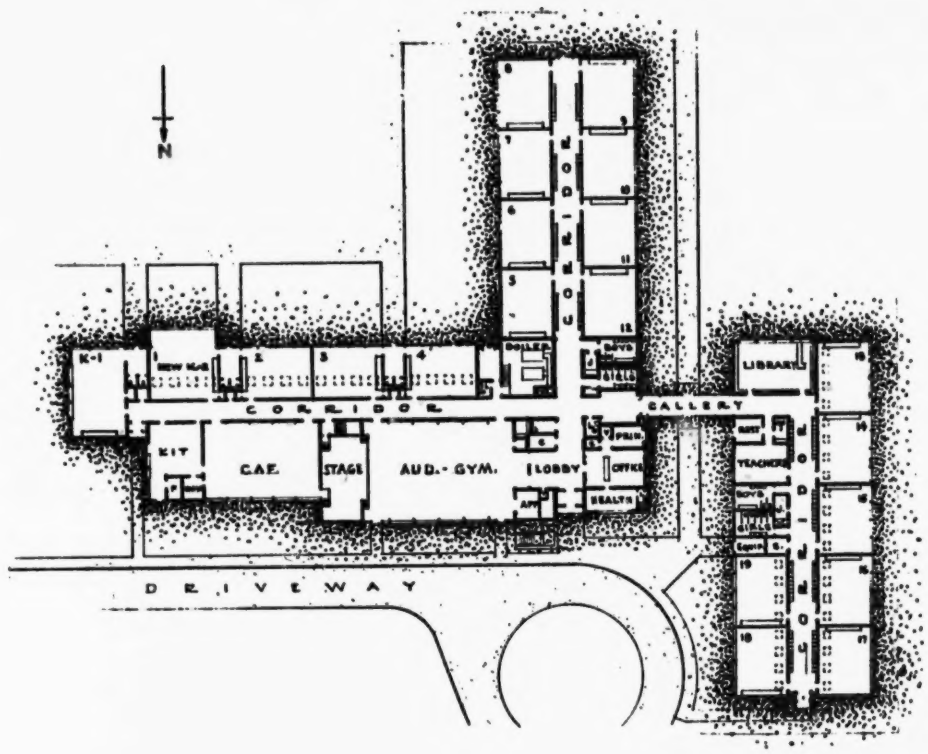
This scheme is essentially the cluster plan spread out and lacking enclosed connecting links between the various units. It gains its name from a superficial resemblance to dispersed collegiate and preparatory school plants which have been built one or two units at a time, often with little or no overall planning. The campus plan offers extreme flexibility for adaption to difficult site conditions and to large-scale, long-term planned growth, as well as often being superior aesthetically. On the other hand, the dispersion offers a maximum of heat-loss, plus circulation, supervision and custodial problems much greater than those found in the more compact layouts. Usually, the substitution of outdoor walkways for some corridors will substantially reduce the percentage of enclosed floor space devoted to circulation, if these conditions are tolerable to the users. Modified campus plans have enclosed corridors connecting the various parts, at an obvious increase in cost as compared with open walkways.



19.

6. *Combinations*

In some cases, variations on combinations of two or more of the above schemes are used to good effect. Usually such combinations come about through circumstances unique to the particular community or to the specific problems or opportunities afforded by the site involved.



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B. MODIFICATIONS

1. *Single-Story vs. Two or More Stories*

Controversy and misunderstanding continue to exist, especially among the unitiated, on this subject. In some cases one will be less costly, in some cases the other. There are too many factors bearing on costs to allow of a clear-cut conclusion one way or the other. Evidence from a number of sources seems to indicate that *in general* one-story construction is slightly less expensive, particularly in the smaller schools.

This much is clear, however, under the Connecticut State Fire Safety Code (and codes of most other states):

a. Stairs, their enclosures, and the space they occupy, cost money.

b. Every floor level above the first requires at least two stairways.

c. Maximum economy in the use of stairs is reached only when there is a maximum permissable distance between stairways. For example, the stairs requried to serve only four classrooms would cost about the same as those needed to serve twelve classrooms.

Some of the advantages claimed for each are as follows:

Single-Story	Multi-Story
Simple fire-safety; all rooms can have direct egress	Less excavation and foundation cost
Simple, economical structure; all floors rest on ground	Less roof surface to buy and maintain
Safety; no stairs to fall down or high windows to fall from	Less site area used or required
Easier maintenance of low exterior	More compact heating, plumbing and electrical installations
Greater design flexibility	Shorter corridors and travel time
Convenience; all horizontal circulation, no duplication of toilets, storage, custodial and instructional equipment	Lower annual heating cost
Less stringent constructional code requirements	
Permits use of outdoor "corridors"	
Superior relationship of interior with exterior, especially for small pupils	

While the single-story building obviously has a majority of advantages, there are situations where consideration of more stories is justified:

In densely occupied urban areas where land costs are extremely high, a multi-story scheme may be the most effective way to achieve a reasonably satisfactory amount of open land for physical education and recreational purposes.

In larger schools (1000-1200 pupils or more) wings tend to become extensive in length, causing long runs for mechanical installations and increased class-passing time. In such cases a second story may justify the additional cost of stairs and the space they occupy, some duplication of equipment, and the other disadvantages of multi-story construction, particularly if sufficient area is served by the necessary number of stairways.

It should also be remembered that some types of school occupancy do not "stack up" well. Classrooms are likely to be uniform in function and dimension, but areas needing long, clear spans such as gymnasiums, auditoriums, cafeterias, large shops, music rooms and so forth, are poorly adapted to carrying the loads of another floor above. Upon analysis, one will find a surprising number of spaces in most schools which can be "stacked" only with difficulty and increased expense.

2. *Split-Level*

Certain parts of schools, such as the gymnasiums, auditorium, cafeteria, music room, shops and so on usually require greater height than classroom and office areas. Where sloping site conditions are favorable, it sometimes proves practical to set such spaces so that all roof levels economically coincide and grade access is available to both resulting floor levels. Two close-coupled arrangements are illustrated here:

21.

3. *Single-Loaded vs. Double-Loaded Corridors*

It should be obvious that twice as much corridor space will be required to serve a given number of rooms, when the rooms are arranged along one side of a corridor only. For economy, single-loaded corridors should be considered only for very compelling reasons.

C. MAKING CHOICES

Because of the many variable factors, any specific prescription for general layout would be unwise and a disservice to those this bulletin is intended to assist.

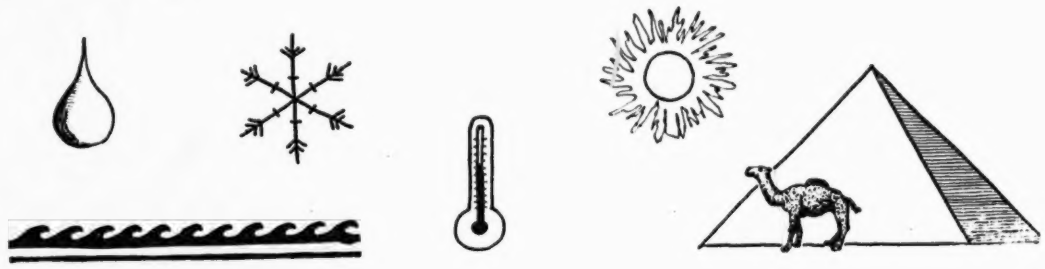
The school building committee engages an architect, choosing one it deems best able to serve them in solving their problem. It is the architect who is best able, after study of a particular combination of methods, materials and circumstances, to indicate the relative cost of various proposals being considered.

The committeeman, in his turn, should bring an open-minded attitude to each situation, giving all possibilities careful consideration. In some cases the appropriate basic type will quite rapdly become obvious. In many other cases much effort may be required to reach a decision. Several schemes may have to be designed and analyzed.

Every proposal should first be scrutinized as to whether it will fully meet the continuing needs agreed upon for the project, and selections made only from those that do. These must then be weighed as to relative cost, both initially, and as regards operating and maintenance costs. Economy is not to be found in cheap expedients that fail to do what is required, cause extra operating expense, or soon require expensive maintenance and repair. Rather, it resides in the solution which will result in the least overall cost for an extended period of time, while performing its intended function well.

CHAPTER V

ENVIRONMENTAL FACTORS AND THEIR CONTROL



The protection of its occupants from an unfavorable environment has been the primary function of man's buildings since long before the dawn of recorded history. The degree of this protection has been increased and refined with the passing years and has reached, in many cases, what currently seems a high level of perfection.

Schools, along with man's other habitations, have undergone a long process of ever-increasing control over environment. Early public schools provided little more than shelter from rain, snow and winds, a modest amount of natural light, and a single source of extremely variable heat, needing constant attention.

However, our nation, along with others, has advanced rapidly in technological developments, industry and standard of living. With these advancements have come improvements in environmental control undreamed of by common men in the early days of our republic. Meanwhile, laboratory and field tests have proven rather conclusively that human beings perform better when they are not distracted by discomfort. Specifically, this means that children and youth can study better and learn more effectively when they do not feel too hot or too cold, when they can see without eyestrain, when they can hear and be heard clearly and easily, when they are not subjected to distracting odors and when their bodies are in relaxed positions. The more effectively a school provides such conditions, the better are the chances for achieving the purposes of education.

It is, therefore, a sourec of economy in the planning of any new school plant, to review the major environmental factors and what, if anything, may presently be done to control them.

A. REGIONAL CLIMATE

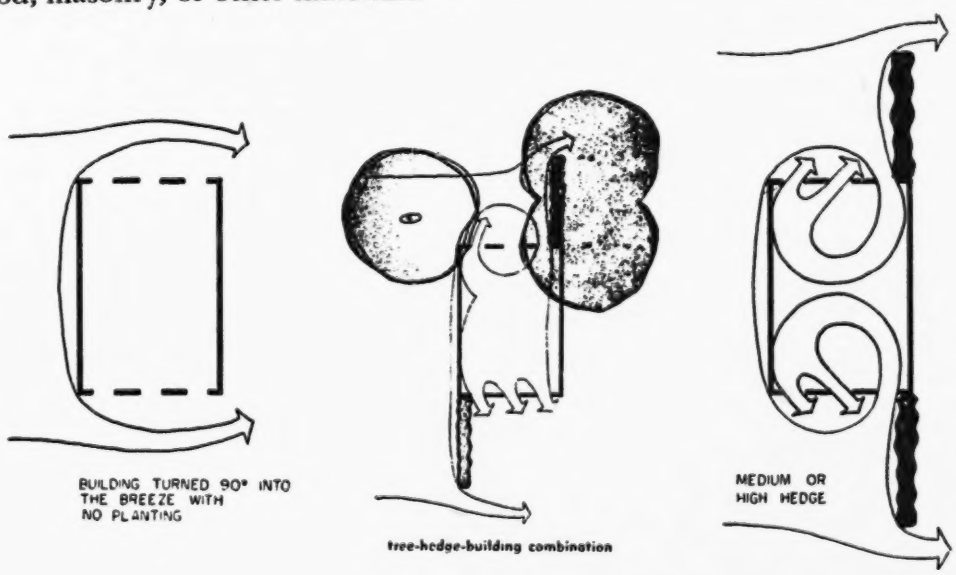
The idiosyncrasies of New England weather are too well known to require comment here. However, even within Connecticut there are variations worthy of notice, such as the relatively cold winters of the high northwestern section, the modifications found in the major river valleys, and the conditions peculiar to the seashore areas. We are not yet in a position to modify our general weather pattern; however, it is well to bear in mind its differences from other areas whose schools may be of comparative interest, as well as to design schools in conformance with our local needs.

B. LOCAL OR "MICRO-CLIMATE"

Each locality proposed for a school will have its own characteristics which modify the regional climate. Such physical features as mountains, hills, slopes, bodies of water, woods and swamps all have their effects on prevailing wind direction, temperature, velocity, and dust content, as well as on the flow of relatively still air masses, humidity and sun-heat.

23.

In many cases, certain features such as trees can be modified through cutting or planting. Slopes can be altered by earth-moving. Wind "funnels" can be grown in time with plant materials, or constructed more rapidly of wood, masonry, or other materials.



24.

However, the principal design factor here is proper layout and orientation, based upon careful analysis of local conditions and needs. In this way maximum advantage can be taken of favorable conditions as they exist and the results of unfavorable circumstances can be minimized.

Certainly every effort should be made in the placement of the building, its design and site modifications, to accomplish these purposes:

1. Proper control of daylighting to avoid glare.
2. Restriction of sun-heat input during hot and warm weather.
3. Maximum natural ventilation during warm seasons.
4. Shelter from cold winter winds, particularly for kindergarten play areas, and if possible for the entire building, especially bus-loading areas and major entrances.

C. TEMPERATURE

Most present-day schools provide heating under fairly close automatic control, and ventilation edequate to avoid objectionable odor build-up. Unfortunately, a substantial number still seem to have been designed in ignorance of the discomforts that accompany overheating.

Schoolroom, quite different from many other types of occupancy, are subject to rapid load fluctuations. The sudden influx of a group of active youngsters plus the heat generated by the lighting system, frequently changes the situation radically. The room which required heat input to maintain a set temperature soon becomes seriously overheated, even after controls have turned off all artificial heat. Or worse, the heating system may lack sufficient flexibility for a quick reaction, and continue to pour in heat. The space now requires cooling. Remedies include the following possibilities:

1. *Minimizing Sun Heat Input*

This is the first line of defense, and practical only during the design stage. It can be simply accomplished by facing major window areas to the north where there is no problem, and to the south where properly designed shading devices will protect interiors during the warmer months. Reflective roof coatings and insulation are likewise useful in reducing the severity of the problem.

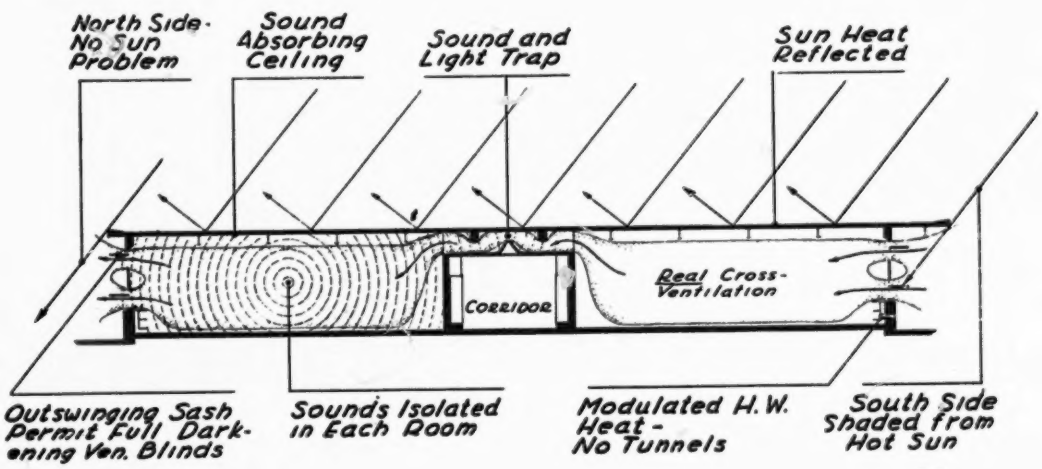
2. *Air Movement*

When outdoor temperatures are sufficiently low (50-60°F., depending on other factors) draftless introduction of outside air through unit ventilators or central fan system is reasonably effective. Somewhat more drafty, but reasonably effective, is the introduction of outside air through deflector-equipped windows or louver panels, assisted by power exhaust fans on the interior.

As outdoor temperatures go higher, noticeable air-movement (draft) is increasingly necessary to maintain a feeling of comfort. Substantial air-movement may be had in two ways, one dependable, the other not:

a. By means of powerful fans and capacious ductwork the vast quantities of air necessary can be moved, but only at high initial and operating cost.

b. Natural outside air-movements can be used. When sufficient openings are provided in an outside wall, even gentle breezes will move huge quantities of air through an interior, *provided* there is a corresponding sufficiency of opposite openings for the egress of the air which tends to come in. This, too, requires careful thought during the design stage; prevailing winds must be considered, as well as land contour, building shape, and the location of existing and new plantings. This method has small initial cost and no operating expense, other than manual adjustment of outside openings.


North Side - No Sun Problem
Sound Absorbing Ceiling
Sound and Light Trap
Sun Heat Reflected
CORRIDOR
Real Cross-Ventilation
Outswinging Sash Permit Full Darkening Ven. Blinds
Sounds Isolated in Each Room
Modulated H.W. Heat - No Tunnels
South Side Shaded from Hot Sun

In either case, limits to effectiveness are reached when air velocity becomes so great as to be annoying, or when outdoor air temperatures rise much above 85-95°F.

3. *Mechanical Cooling*

Well known for many years by the name of "air-conditioning", mechanical cooling by various methods is in common use in a great variety of occupancies, particularly those which operate during midsummer heat or involve compact concentrations of people.

Mechanical cooling has been installed in a substantial number of new schools in recent years, including some in areas having climates little different from Connecticut's. In other cases, cooling has been provided only to those areas to be used in the summer season, such as administrative offices and auditoriums, where the need is greatest.

Other things being equal, there is no question but that mechanical cooling costs more to purchase and operate than not having it. However, when the use of an expensive and needed facility is impractical without it, its use is obviously justified.

There have, it is true, been case studies published which indicate certain mechanically-cooled school buildings to be slightly less expensive overall than their conventional counterparts. These usually seem to be

extremely compact structures, wherein the savings from compaction more than compensated for the cost of purchasing and operating the additional equipment. While this would seem more of an argument for compaction than for cooling, it should be borne in mind that such a degree of compaction in a large school is not usually practical without the mechanical cooling.

As is true of so many aspects of school building design, no hard and fast rule can be laid down here. However, for the committee considering mechanical cooling, here are some points to ponder:

a. Mechanical cooling is especially expensive to install *after* construction in a building not originally designed for it.

b. The cost of installation and operation is greatly affected by the heat intake of the building; every effort must be made to design the building so as to prevent heat from entering during warm weather; it costs money to pump it out again mechanically.

c. If local long-range planning indicates summer time use of a proposed school in the future, consideration should be given to planning the mechanical installation to make future cooling easy.

d. Any initial installation of mechanical cooling should be authorized only after a very thorough and realistic analysis of installation, operating and maintenance costs, together with those of any concurrent modifications necessary to the design of the structure on account of the cooling.

D. SEEING CONDITIONS

Of the total amount of energy expended by pupils in a typical sedentary classroom situation, an astonishingly high percentage is used solely for the task of seeing. Since so much of the learning process is visual, it follows that every effort should be made to provide good seeing conditions for children and youth in our new school buildings, if these buildings are to function efficiently.

The basic necessity for all seeing is *light*. Whether natural or artificial, light has certain attributes which are of the utmost importance in its efficient use:

Quantity of light is usually measured in units called "foot-candles." The quantity of light falling on a surface is measured thus, regardless of whether any amount is reflected back. There is, of course, a lower limit to the quantity of light required for sustained comfortable seeing.

Brightness of any surface emitting or reflecting light is measured in units called "foot-lamberts." Major differences in brightness within a person's field of view cause "glare." Common examples of glare are automobile headlights at night, printed materials on shiny paper under bright light, and similar situations. Limits have also been determined for the ranges of brightness contrast which will permit comfortable seeing conditions in various types of schoolroom situations.

The control of seeing conditions, then, given suitable contrasts in the work itself, involves manipulation of light sources and reflective surfaces so as to assure an adequate *quantity* of illumination without extreme *brightness* contrasts in the field of vision.

1. *Sources of Light*

a. *Natural* light from the sun, both direct and through cloud-cover, sky-shine, and ground-reflection is provided to us at no cost. However, it is extremely variable and capable of causing extreme brightness contrasts due to its brilliance. Schools which are to be used only in daylight hours should logically seek to make use of this economical light-source; however, taming th sun's brilliance while providing for adequate cloudy-day illumination requires considerable ingenuity in planning window locations and sizes, as well as integrating the design of windows and shading devices.

b. *Artificial* lighting has in recent years reached a high state of development and is capable of producing almost any kind of seeing conditions desired. However, as with most of man's inventions, the cost is approximately proportional to the quality of performance. Furthermore, of course, operating costs are a significant item year after year. Where a school is to have night time use, there is obviously no recourse from the provision of adequate artificial lighting designed without consideration of daylighting.

c. *Combinations* of natural and artificial lighting have actually been in use for many years. Unfortunately, the majority of these, intended for daytime use, have artificial lighting systems uneconomically designed to be adequate for night time use, with natural daylighting (frequently of poor quality) added. This natural light, and particularly direct sunlight, is frequently so bright as to be objectionable, causing the common phenomenon of drawn shades and blazing electric lights on a clear sunny day! This is a condition hardly to be regarded as economical.

A much more rational approach, for schools intended for daytime use only, would seem to involve proper orientation and shading to prevent direct sunshine glare, and the provision of artificial lighting sufficient only to supplement cloudy-day natural light. This can provide an adequate minimum of good quality light for the least initial and operating cost.

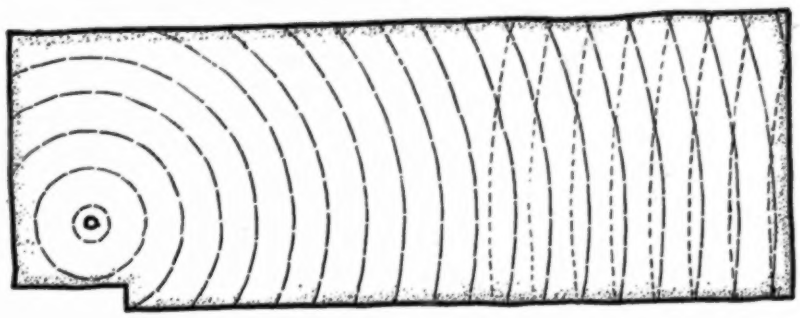
Of artificial light sources, fluorescent and incandescent lamps are almost exclusively used today. Fluorescent lamps and fixtures are most expensive initially, but are more efficient, hence operating costs are less. Where substantial levels of artificial light are to be supplied most of the time, fluorescent lamps will almost invariably be most economical in the long run. Incandescent lamps find their uses in areas where lights are infrequently used (such as storerooms), where relamping is difficult or service rough (gymnasiums), or where light must be aimed or varied in intensity (stages), and outdoors, where ordinary fluorescent lamps do not function well.

Where only daytime use of a school or part of a school is contemplated, and where artificial lighting only supplements daylight, incandescent lamps may prove more economical, but this should only be concluded as the result of careful cost analysis.

E. HEARING CONDITIONS

There are many misunderstandings concerning acoustics. There are three basic causes of acoustical problems in school buildings:

1. *Reverberations* within occupied spaces are the cause of garbled speech through rapidly overlapping echoes. This problem increases as a space becomes larger and "reverberation times" become longer. They are accentuated by parallel and hard sound-reflecting surfaces. Gymnasiums, auditoriums, cafeterias and similar large spaces are particularly susceptible to these ailments. Sound absorbent and non-parallel surfaces usually are utilized to avoid these manifestations.



26.

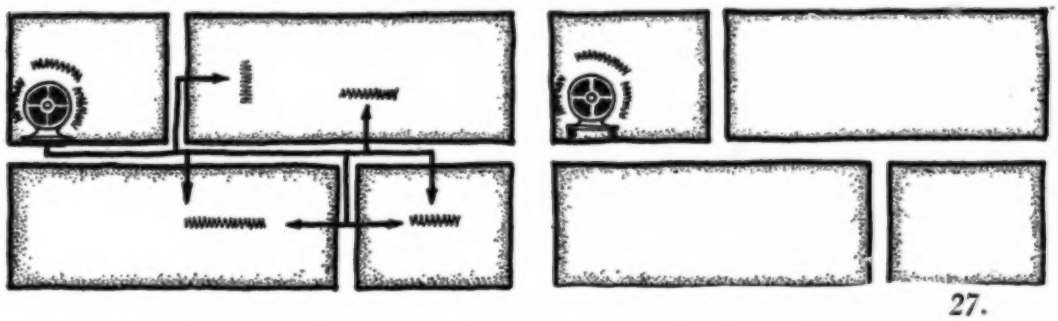
However, a great many classrooms built during the post-war years are provided with an excess of acoustically absorptive surfacing. A room can be made acoustically "dead" by too much acoustical treatment; all that is needed is sufficient to suppress reverberations. Obviously, it is wasteful to provide at extra cost, absorptive treatment which is not required, or even gives undesirable results.

2. *Transmitted* sounds from one area to another are the major cause of acoustical problems in schools, problems with which the usual surface "acoustical treatment" furnishes little help. The initial design step to take, when possible, is the physical isolation of spaces where noise is generated, such as music rooms, shops, gymnasiums, locker rooms and cafeterias. These areas, being noisy, can sometimes be compatible neighbors.

Where a noisy area and one requiring quiet are necessarily adjacent, acoustical separation is required. Massive or at least double non-connecting partitioning is usually necessary and in some situations an exterior wing-wall will also be needed as an acoustical baffle to prevent outdoor transmission from one space to another.

Noise-producing machinery will usually require cushioned mountings if sound is not to be transmitted long distances through the structural

system. Fans, generators and compressors are frequent offenders in this respect:



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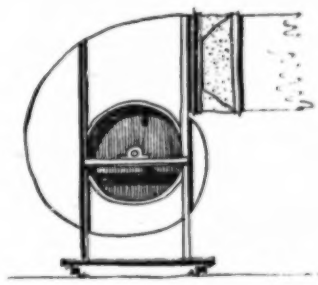
Air-moving is a frequent cause of distracting noise, and ductwork often permits transfer of sounds from one space to another. Proper treatment of the ductwork interiors and isolation of fans therefrom will improve this situation:



28.

A common source of exasperating noise in school assembly rooms is the direct unit heater and unit ventilator. While these are indeed relatively inexpensive, they frequently are so noisy as to inhibit seriously the intended use of the space, which is hardly economical. Installations for assembly areas should be carefully designed to avoid such unwanted noise where quiet is so often essential.

3. *Exterior noises* from play areas, nearby road and aerial traffic and industrial activity can become difficult problems.

Play areas, if possible, should be located away from windows of rooms requiring quiet; a direction opposite to that of the prevailing wind can also be helpful, and suitable plantings appropiately located can also be of some assistance.

Motor traffic noise is best avoided by the same means as play area noise, but the only apparent solution to troublesome aerial traffic noises is the "sealed" building, preferably with doubled glazing on windows. Since this is expensive, the problem is better avoided by proper site selection in the first place, whenever possible.

F. DUST AND DIRT

The locally prevalent type of soil sometimes gives rise to much dirt and dust inside buildings. Vegetable-growth binders are the best solution to dusty soils; in difficult cases expert advice on soil treatment and planting materials is essential to success.

The tracking in of play-area dirt to a school building, particularly if it is gritty dirt, can cause considerable damage to floors and a great deal of extra expenditure for custodial services. Suitable paved areas and walks thoughtfully located can do much to reduce the problem. Specal provisions at entrances may be desirable in extreme cases.

In some localities air-borne pollens, industrial fumes or other objectionable odors may constitute problems. "Sealed" buildings, in which all ventilating air is passed through filters or odor-removing devices or both are the indicated remedy for these problems, but such a site should be avoided originally if at all possible.

G. AESTHETIC CONDITIONS

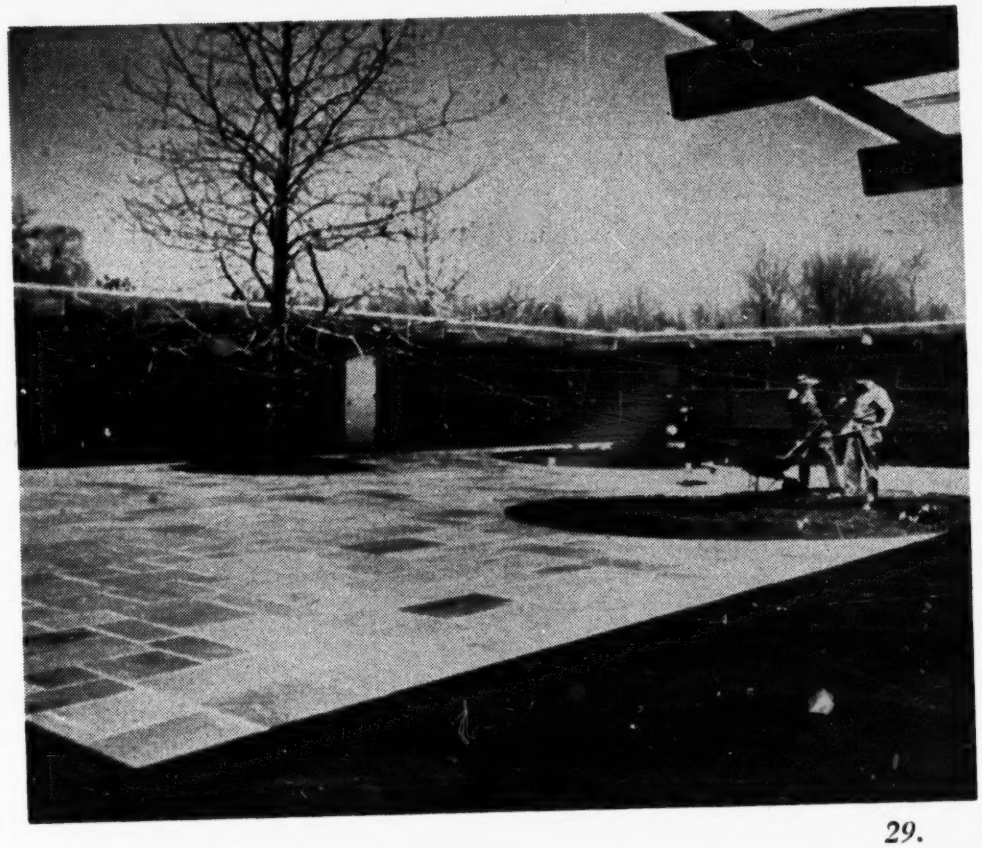
The aesthetic environments to which we are all subjected are relatively intangible. Yet, we all know our reactions to gloomy, dirty, confused, or even sordid surroundings. Conversely, we are all conscious of the lifting of spirit experienced in a cheerful, orderly, and pleasant place that feels right for its intended purpose.

In the design of school plants, major aesthetic emphasis should be laid upon the interior, where the occupants spend so much of their time, including that part of the exterior which may readily be sensed from the inside. The exterior, however, should not be neglected; all aspects should be orderly, friendly and cheerful as can be managed.

Genuine works of art, such as sculpture, murals and the like, are not a waste of public money in a school building, nor are aesthetically satisfying plantings. These can provide daily enrichment to the lives of the pupils, and can symbolize for them the importance attached by the local citizenry to their program of education for their children. It is interesting to note that several European governments require the budgeting of one per cent or more of project funds for works of art in pubilc buildings, and that it is uncommon there for a school to lack such civilizing amenities as flowers and plantings.

The end results of efforts in this direction cannot be measured any more than the pleasant or friendly appearance of a home. Yet all realtors know full well that buyers will pay more for properties which have these intangible qualities. In the same way, a school building endowed with aesthetic excellence is worth something extra to the community it graces, even though it cost no more than a mediocre design. It is also well known that where pupils enjoy and are proud of their school plant, custodial problems dimin-

ish and vandalism is reduced. Good architecture, then, is good business. It seems a poor policy, indeed, to resist efforts toward such excellence on the mistaken assumption that it is "not economical".



29.

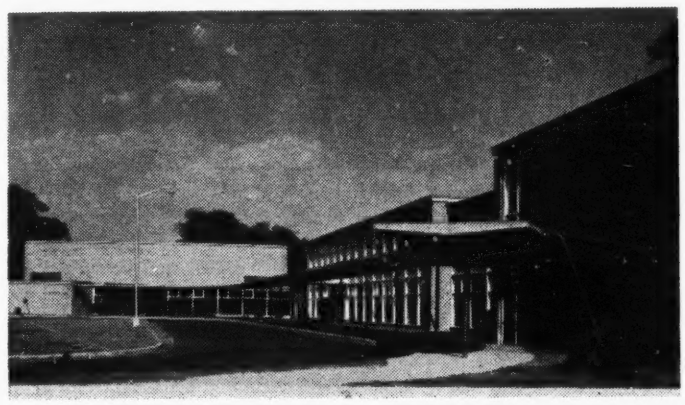
CHAPTER VI

RELATIONSHIP OF PLANNING ELEMENTS

Having done his best in establishing the basic elements on the site, the architect must next address himself to the development of proper and convenient relationships among the various parts of the school plant:

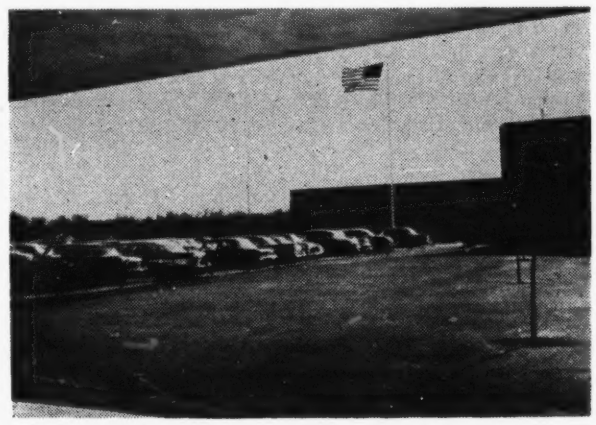
A. INTERIOR-EXTERIOR

1. *Bus drives* should proceed directly to ample and suitable unloading areas, which in turn are reasonably central to pupil destinations.



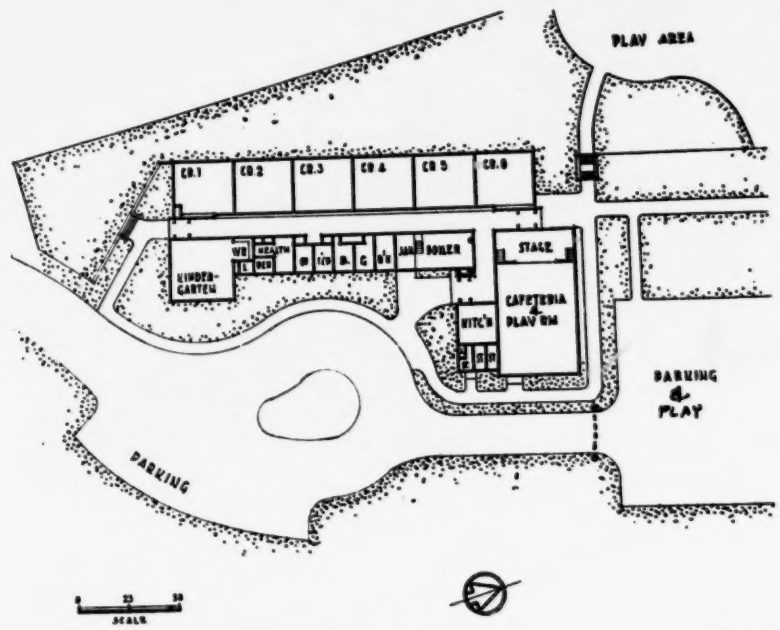
30.

2. *Staff parking areas* should be reasonably convenient of access to an entrance and to visitors' parking and administrative area.



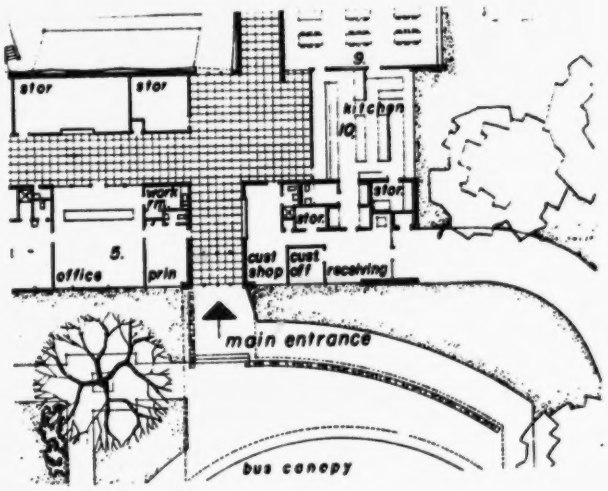
31.

3. *General public parking* for non-school activities should be convenient to the place of assembly and also arranged to be normally segregated from drives, so as to use them for paved play areas during school hours.



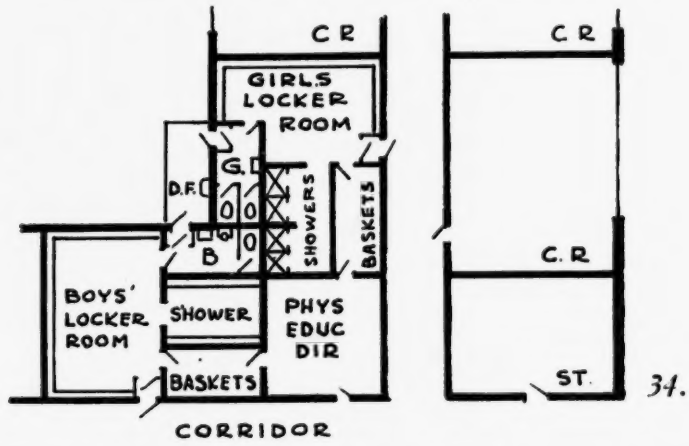
32.

4. *Drives for service vehicles* should go directly to food preparation and custodial areas with a minimum of hazard to pupils.



33.

5. *Physical education locker rooms* should communicate as directly as possible with outdoor physical education areas; if possible, toilets should be available directly from the out of doors.



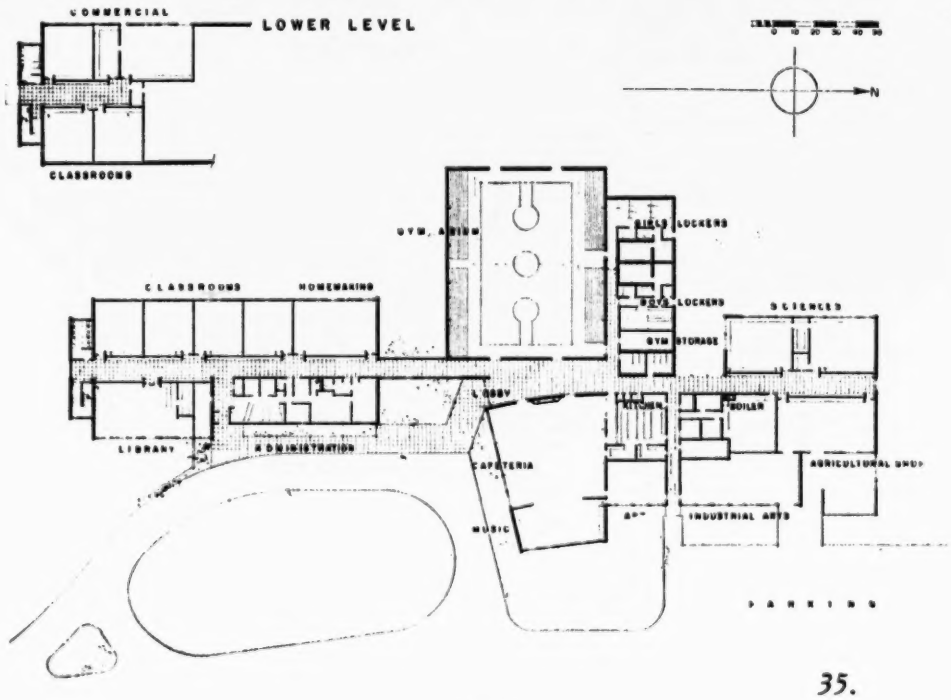
34.

6. *Noisy exterior play areas* should be isolated as well as can be from interior spaces where quiet is normally required.

B. INTERIOR

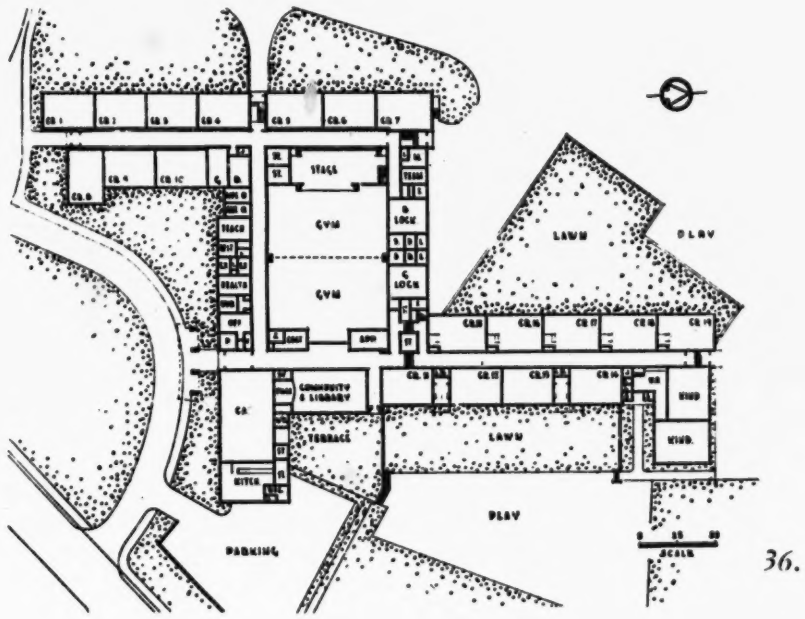
Primarily, these relationships are dictated by the requirements of the particular educational program. Too many ramifications exist for general coverage, but some items common to most schools are:

1. *Noisy areas,* such as music, shop and physical education are best separated from areas requiring quiet, such as academic classrooms, library, administration and health unit. The following example illustrates an appropriate separation.



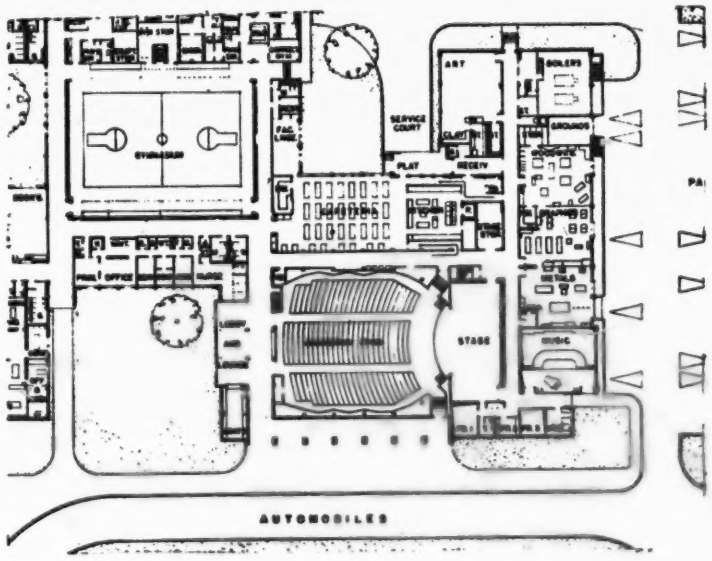
35.

2. *Common-use areas,* such as library, auditorium and central administrative offices should be as central to all pupils as is practical, consistent with other factors, such as noise or convenient access.



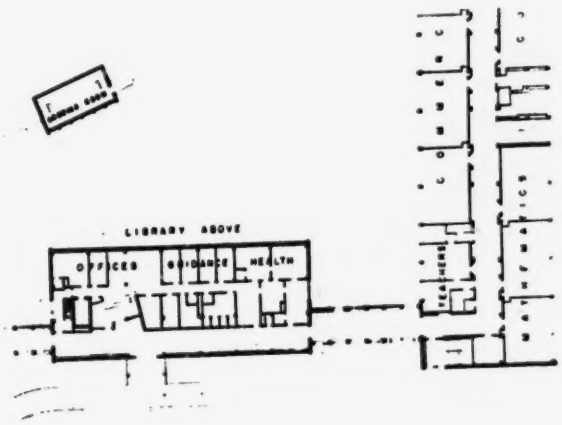
36.

3. *Stage* of auditorium is often closely associated with music, shop areas, and sometimes art and English, and should have access without going through the auditorium itself.



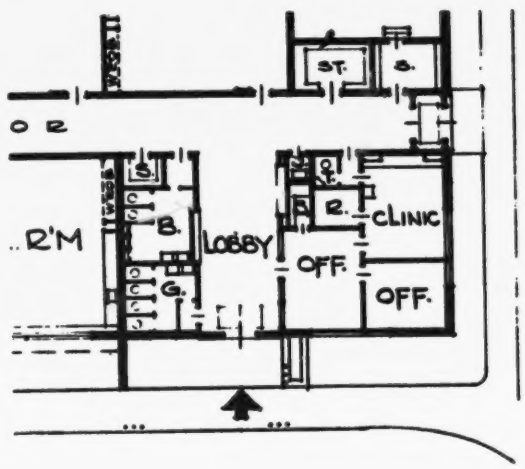
37.

4. *Guidance* facilities are frequently closely associated with administrative offices for staff convenience and access to pupils' records.



38.

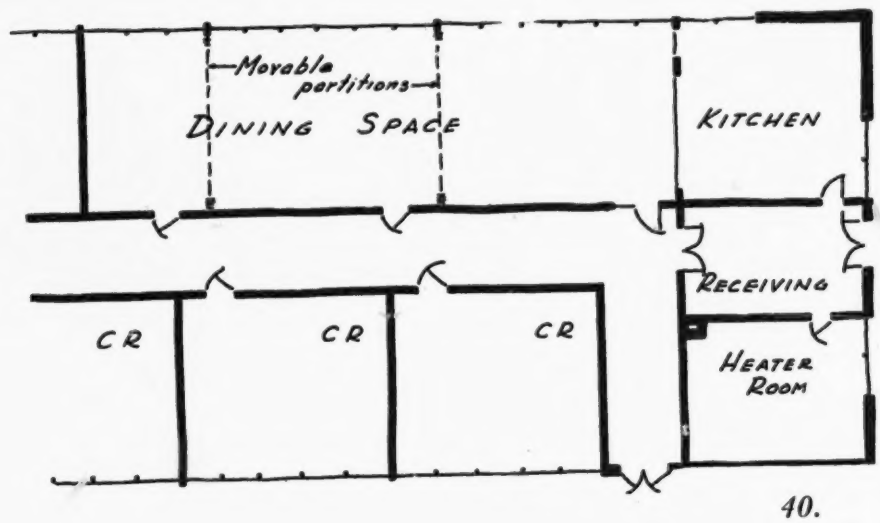
5. *Health Unit* in schools not having a full-time nurse may conveniently be placed adjacent to the general office for supervision and availability of secretarial services and pupil records.



39.

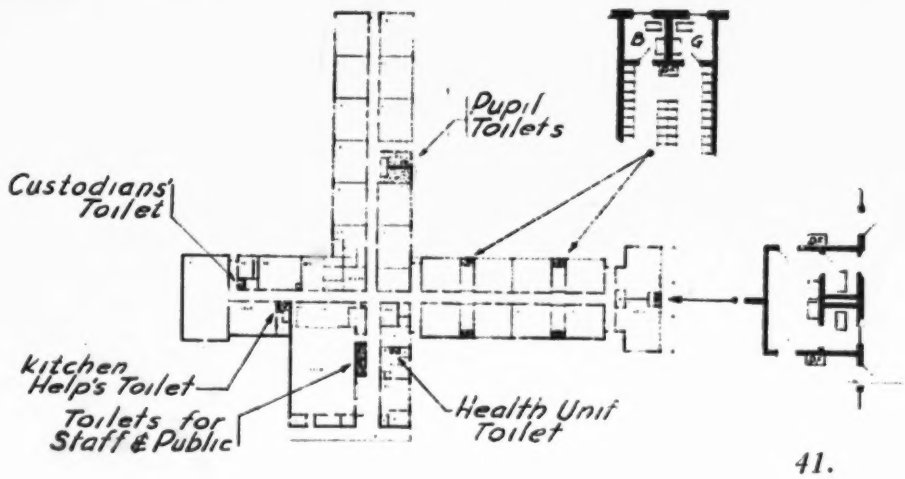
6. *Service Spaces:*

a. *Food Service* should be so situated that dining area can conveniently be utilized for other educational purposes, but if possible, so that cooking odors and noise cause no distraction to classroom areas.



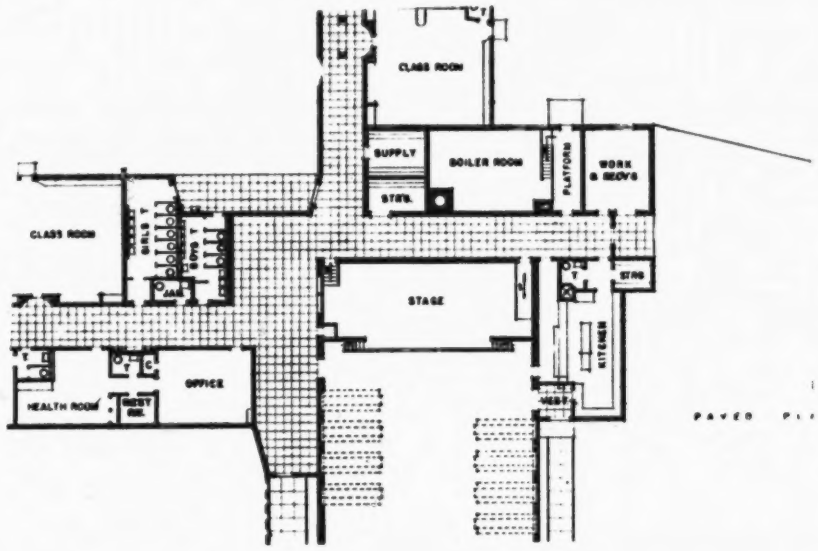
40.

b. *Toilets* should be situated conveniently to pupil areas. Lower elementary pupils may often be provided with at-room toilets. Staff toilets should be located so as to serve as public toilets during non-school activities. When weekend and vacation use of the grounds is expected, some toilets should be located so as to permit use from exterior without general access to the interior of the entire building.



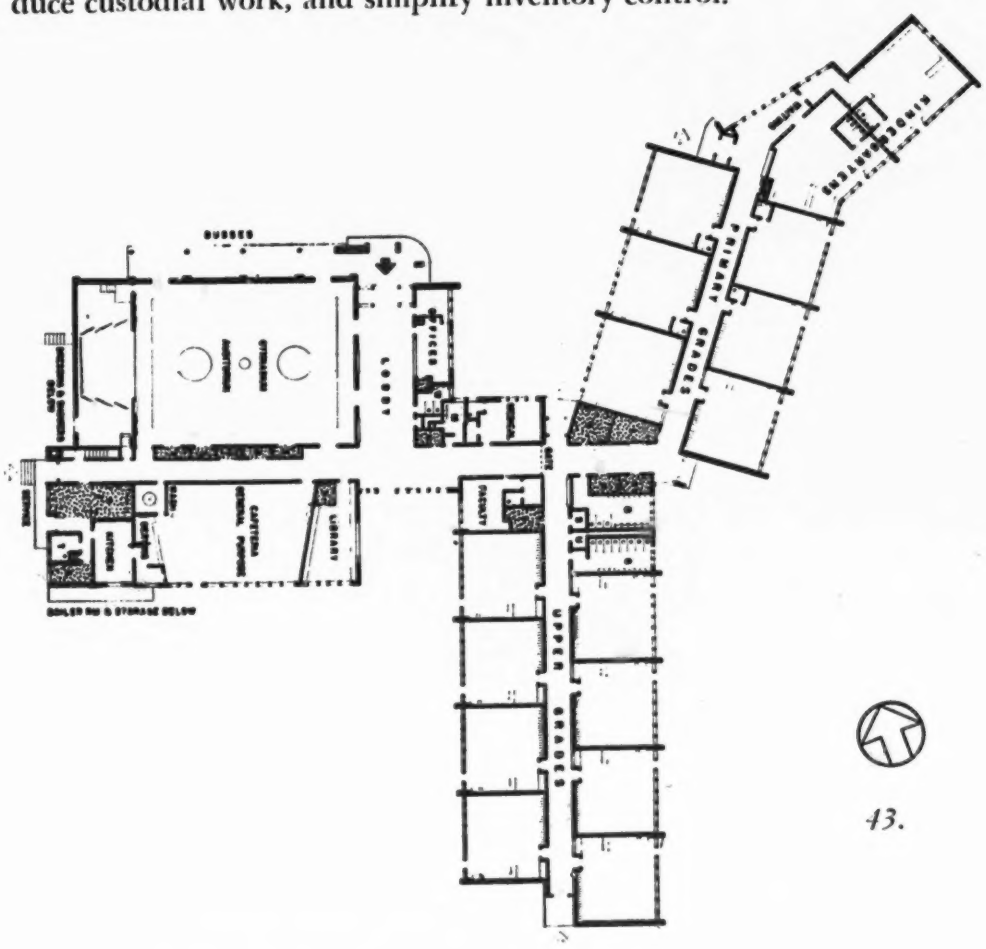
41.

c. *Custodial* needs usually require a suitable receiving area with general storage and possibly a workshop, plus smaller custodian's rooms located conveniently near point of use for cleaning equipment and supplies.



12.

d. Supplies storage rooms strategically located near point of use will generally minimize the need for expensive in-room storage facilities, reduce custodial work, and simplify inventory control.



43.

CHAPTER VII

TAKING ADVANTAGE OF THE SITE

The cost of acquiring and developing a school site is usually a substantial portion of the total school budget.

Substantial sums can be saved through proper selection of a school site, and for a discussion of the matter the reader is directed to Bulletin No. 3 of this Series, "School Sites – Selection and Acquisition".

Once a site is determined upon, maximum economy demands that its development be planned so as to satisfy as many project requirements as possible for the least amount of money.

In the development of any school site, the architect almost invaribly encounters situations or combinations of problems different from any previous one. A new solution must be worked out each time. No old answer will do.

In a sense solving the site problem is often somewhat like a juggling act, since a number of factors must be considered and dealt with simultaneously. Seldom can all needs and desires be fully satisfied; instead, the best possible compromise must be worked out among them.

A. The major items to be accomodated on the site are:

1. The building or buildings
2. Athletic and recreational areas.
3. Approaches and parking areas.
4. Spaces for future expansion.
5. Utilities, such as water-supply, electricity, fuel, yard equipment, sewage disposal and storm-water drainage.

Each of these must be located in the best practical relationship to the others for optimum performance, and yet with minimal cost consistent with function.

B. While attempting to establish what these locations should be on a particular site, serious consideration must be given to these factors:

1. *Existing Features* – Favorable features, such as trees, brooks, woods or ponds should be capitalized upon wherever possible, designing the building and the exterior features accordingly. Brooks, woods and ponds can become most valuable adjuncts to science education – an "outdoor laboratory" bringing reality and meaning to classroom study. A suitable hill or pond may provide countless hours of healthful wintertime sport for the children and youth of the community. A suitable hill or the side of a gully may lend itself to modification as an outdoor amphitheatre, used not only by the school but also by community groups. Often such matters may not appear in the statement of project requirements but a perceptive building committee and architect, sensitive to community needs, can often build into a project for more value than was originally expected.

Naturally, funds may not be available initially to make such developments. But such a lack is no excuse for ignoring possibilities. With relatively little effort they can be planned for eventual development as a part of the overall, long-term concept.

Occasionally an apparent disadvantage can be transformed into a plus value. For instance, the rock outcropping that looks so formidable while thinking about excavation may be very welcome to children eager for a place to climb. Try to see the site as it might be, through the eyes of a child; it may be a very rewarding experience!

2. *Sub-surface Conditions* — No structure of consequence should be located or planned without an adequate investigation of sub-surface conditions. The extent of such investigation depends upon local conditions and should be determined only on the advice of the architect and his structural engineer. The purpose, of course, is to avoid sub-soil conditions such as water, rock, wet clay or other poor bearing strata. A catalogue of the committees which omitted such precautions would include some very sorrowful and costly experiences. The cost of such an investigation may be saved many times over.

3. *Economizing on Utilties* — Wherever practical, structures should be so located as to minimize the length of utility runs. Roads, drives, walks, electric service entrances, sewers and storm-water drainage all have costs in proportion to the distances or areas covered. Tentative building locations should be modified, wherever practical, so as to permit the shortest practical runs. In the case of storm-water drainage, careful grading for surface run-off should be chosen in preference to sub-surface lines whenever conditions permit; storm-water sewers, with their catch-basins, manholes and headwalls can absorb substantial sums of project money.

In the case of paving, as with many other items, cheapness is not synonomous with economy. School busses and service trucks are heavy and pavement must be substantial if it is to last. Walks and curbs to which busses draw up should be of concrete. Paved areas for play, car-parking and walks can be of a lower type of construction than the main drives. Sealing the surfaces of bituminous pavements against oily solvents where cars will park is a wise precaution. Minor walkways can economically and satisfactorily be made of "black-top" paving materials.

CHAPTER VIII

PROVIDING FOR EXPANSION AND CHANGE

The extraordinary increase in births, resulting in the mounting of pupil enrollments in recent years, coupled with the sharply increasing mobility of our population, has caused and will continue to cause school plant expansion as well as all-new units.

Concurrent with the rapidly accelerating rate of change in our society's technology is an increasing rate of change in the organizing of instructional programs and methods. As a result, forward-looking educators, building committees and their architects feel strongly the necessity for "planning in" appropriate flexibility for changes yet to come, and see this as part of economy.

The future cost of both expected and unforseen changes can be greatly minimized through the employment of the following approaches or their variations and combinations:

A. EXTERNAL EXPANSION

1. *Wing extensions* are usually the first thought and they can be simplified through preparing the way for them by:

a. Avoiding placement of important windows or other openings at end walls where extensions may occur.

b. Setting any stairways outside of any future corridors.

c. Providing ready-made connections for future heating, plumbing and wiring.

d. Indicating such intentions on the original drawings.

2. *New Units* provide the answer in cluster or campus plans, and often in non-expandable compact plants; they are greatly facilitated by:

a. Reservation of suitable space for the purpose.

b. Provision of additional utility connections and capacity to serve them.

c. Indicating such intentions on the original drawings.

B. INTERIOR CHANGES

1. *Long-term flexibility* involves provisions for relatively economical changes at possible intervals of several years. Such changes may take either or two basic forms:

a. *CONVERSION OF SPACES* from one use to another is frequently possible, for example, changing an academic room to provide for expand-

ing administrative needs. Specialized departments can expand into non-specialized adjacent classrooms, replacing these with new facilities elsewhere in the building.

b. *AREA CHANGES* within spaces and departments, call for relatively inexpensive partitions with a minimum of mechanical installations therein, which can be easily torn down and scrapped when change is required. Where laboratories are involved, access to piping beneath the floor or elsewhere makes such future changes more simple and economical. If two or more partition changes are foreseen, movable, salvable partitioning will usually be more economical in the long run.

2. *Constant Flexibility* means the ability to change with relative speed, and requires such provisions as folding or movable partitions, movable equipment and such related devices as may be necessary to the particular type of changes required by the educational program determined upon.

C. MECHANICAL INSTALLATIONS

Along with the structure, various utilities should be planned for any anticipated changes and for needed constant flexibility.

1. *Heating plant* expansions, when not planned for, can be both difficult and expensive. Some of the means usable to forestall such situations are:

a. Heater room, stack and fuel storage can easily be sized to accommodate expansion. Some types of boilers may be expanded by adding sections and modifying the burners. Initial oversizing of a boiler is usually an economy measure if future expansion is a fairly sure thing.

b. In any case where a future need for cooling is clearly seen, the system should be so designed to be compatible with its easy installation later.

c. Zoning of controls is a logical means of assuring built-in flexibility for use in connection with after-school and evening activities, so that portions may be comfortably heated and ventilated without wastefully heating the entire structure.

2. *Plumbing System*

a. Concealed piping, without fixtures, can be easily provided at the outset for expected expansions in capacity or known changes in space assignment.

b. Water supply systems should provide sufficient quantity and pressure to care for expected future loads if at all possible.

c. Sewage disposal systems can easily be designed with septic tanks sized for future capacities rather than initial loading; leaching fields can be laid out for initial load, with space reserved for later expansion.

3. *Electrical System*

a. Service entrance wiring and equipment should be sized to accom-

modate anticipated future loadings; replacement to reach the next larger size or so is usually a costly and wasteful procedure at a later date.

b. Spare distribution capacity should be provided for expected future loads. Where future wings are planned, feeder conduit should be extended to the location involved, so that existing work will not have to be disturbed when the later addition is built.

c. Auxiliary systems, such as clocks, alarms, bells, public-address and television should be so designed and installed to accomodate future expansion without difficulty.

The foregoing, however, is not intended to mean that all school plants should be planned for major expansion. The need for expansion is primarily a matter for determination by local school authorities, as a matter of educational policy. When this policy is definitely against expansion of capacity beyond a certain point, extra initial expense to facilitate such expansion beyond that point is clearly unjustified.

Certainly, therefore, a clear-cut position in these matters is one of the essentials basic to the design of any new school plant. Given such information, many wasteful practices can be carefully avoided.

CHAPTER IX

LOOKING TO THE FUTURE – DEVELOPING TRENDS

A. ECONOMY THROUGH ANTICIPATION

1. *Changing Times*

Rapidly moving world events and technological advances, plus increasing enrollments and a lack of qualified teachers, have caused extensive re-evaluation of educational methods at all grade levels. As a result, certain trends toward change are developing of which all school plant planning participants should be acutely aware.

While there is by no means general agreement on the merits of these emerging changes, they all have the common objective–increased effectiveness of the educative processes. To use the terms of industry, this means lowered "production costs," an "improved product" or both. In any event, the intended result is greater efficiency in the education of children and youth.

In view of the advances in our knowledge through research, and mounting social and economic pressures on our school systems, changes of some sort, and at some early time, seem almost inevitable.

2. *Implications for School Building Economy*

Any significant change in the function of a building type requires corresponding change in the design of the building to accomodate the change. Certainly, then, any change in educational methods is likely to necessitate differences in school building design.

If we can be reasonably sure of change during the expected life of a school plant, it clearly behooves us to design the plant accordingly. This should effect economy in two ways:

a. By avoiding the great expense of future major changes to a building ill-adapted to changing methods of education.

b. By facilitating the earlier adoption of educational methods which either save money, or which make the educative processes more effective.

Changes from conventional designs that may be practical at the time of initial construction are:

c. Different arrangements at the outset will be indicated if an unusual educational program is to be operative immediately after the school is occupied.

d. Flexibility for change, in either of two ways:

1. Instant flexibility – the sort obtained through the use of folding partitions and multiple-purpose spaces. These means are useful both for immediate and future changes.

2. Eventual flexibility — available through the use of removable or demountable partitioning at strategically planned locations, designed to permit anticipated changes with relative ease when necessary.

B. SOME EMERGING TRENDS

Here will be discussed briefly some of the major trends currently prominent in the changing educational field. This is not intended to be a comprehensive treatment of the subject, but rather a short introduction which can be the springboard into a more thorough review of other, more detailed source material.

In some cases, attempts to incorporate these ideas or methods into new buildings have resulted in the invention of new forms for the school plant and its parts, or adaptations and modifications to existing forms. The inclusion of illustrations herein is not intended in any way to encourage haphazard copying of what is new; rather, the purpose is to stimulate imaginative consideration of similar or related problems in each local situation. Here they may stand or fall on their own merits and individual solutions can be worked out to individual problems.

1. *Core Program*

This concept, by no means new, is in common use at junior high school level and has been considered as a transitional stage between the "one teacher for one class" arrangement of elementary schools and the "one teacher for each course" common in the senior high school. In this type of program, each class has one particular teacher for the core subjects such as English, social studies, and mathematics, but goes to other teachers and departments for specialized subjects such as science, physical education, industrial arts, business education and so forth.

However, recent trends seem to indicate an expansion of this scheme downward into the lower grades and upward into the higher grades. Those responsible for school design should inquire into each local situation for signs of movement in these directions, so as to make adequate preparations for such changes if they seem indicated.

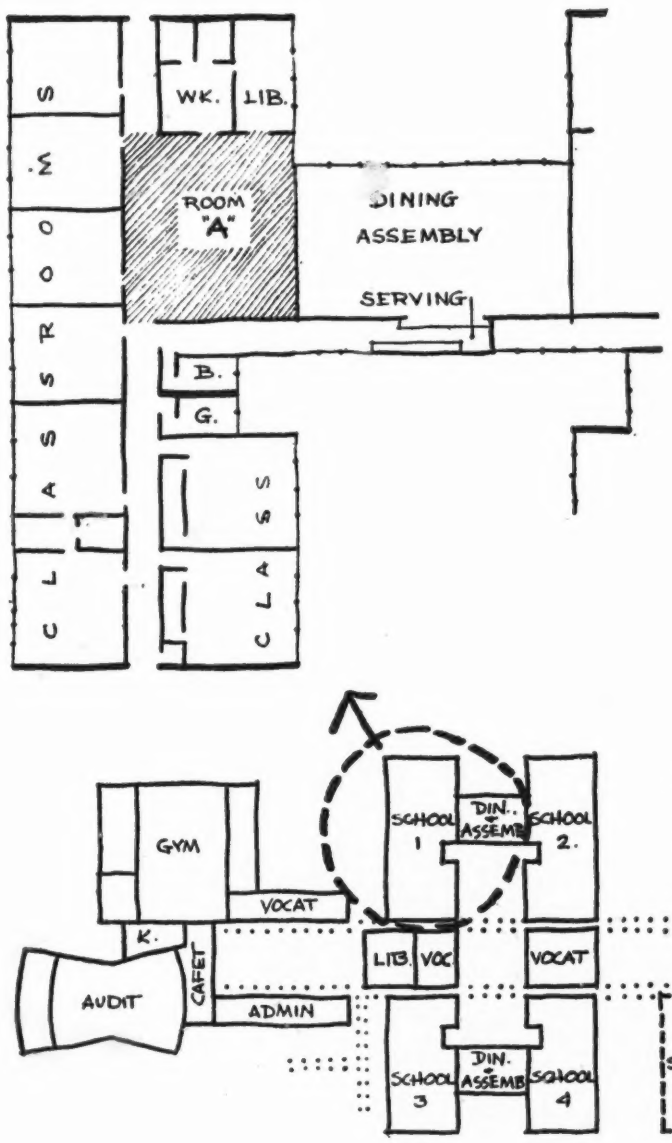
2. *House Plan*

This scheme, sometimes called the "school-within-a-school" is intended to minimize some of the less desirable aspects of the larger schools, especially at the secondary level.

The fundamental idea is the division of a large student body and faculty into groups of 300-500 pupils each. Each group is then organized as a separate smaller "school" with its own basic faculty and facilities. However, with this type of organization, each "school" usually shares in the use of such specialized and common-use facilities as physical education, auditorium, music, industrial arts, business education, homemaking, health unit, main library, food service and administration. In this fash-

ion each "school" has available to it specialized facilities of an order not usually possible for smaller school, yet a high degree of use-efficiency is attained and the operating efficiencies of a large school are realized. Meantime, the pupils have the advantages inherent in a small school, such as more intimate contact with the faculty, better opportunities to participate in various activities, and much stronger sense of identity in the student group.

While this plan has been operated in older, conventional school plants, it is only natural that it can best be done in a plant designed especially for it. The cluster and campus layouts seem to lend themselves particularly well to this scheme and provide for simple expansion on a similar basis by adding one or more "schools" to the original plant, if common-use facilities are designed to be adequate for such increases.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SCHOOL 4
SCHOOL 5
SCHOOL 6

44.

3. *Year-round Use of the School Plant*

The beginnings of this trend are visible in greatly increased evening use of school facilities by community groups and more lately in a vast increase in "summer-school" activities at high school level.

With increasing pressures for school facilities and the rapidly increasing popularity of off-season vacations, attention is becoming focussed on the possibility of year-round use of school plants as an economy measure.

Schemes for such use are various and in some cases complex. However, they all have in common the implication of summertime use and the problems attendant therewith. First among these is the need for adequate environmental controls to minimize heat-intake.

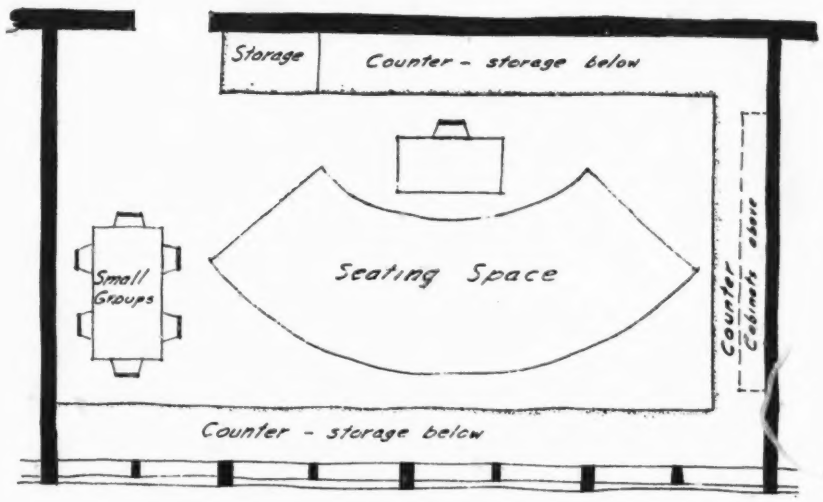
Serious consideration is urged, especially in the case of secondary school plants, as to whether year-round use may come to pass during the useful life of the building. If the conclusion, after study, is affirmative, long-term economy indicates the need for special attention to the problems attendant upon summertime use.

4. *Increased Emphasis on Laboratory Experiences*

Evidence seems to be accumulating almost daily to reinforce the conclusion of many educators that the best learning is "learning by doing". This, of course, implies a de-emphasis on lecture courses with information passing "from the instructor's notebook to that of the students without passing through the minds of either," in favor of actual laboratory learning by each pupil or groups of pupils.

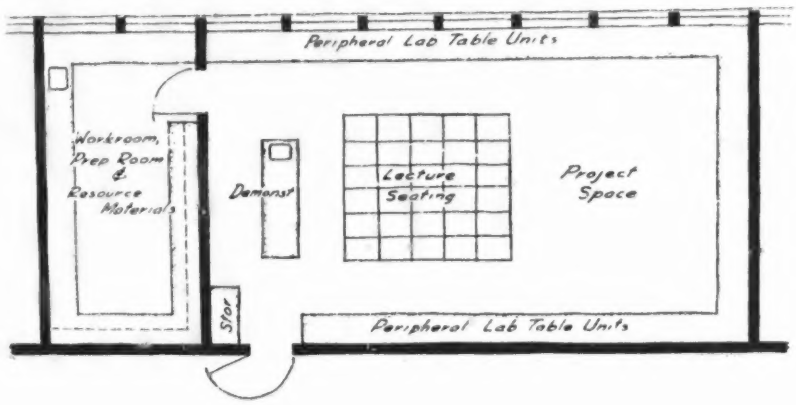
This trend is particularly noticeable in the fields of mathematics, science and foreign languages.

a. *Mathematics* — In this field the desire is for the ready availability of devices and equipment used in the application of mathematical principles. Naturally, the design of the facility should be accommodated to the materials to be housed and used, which in turn depends upon the grade levels involved.



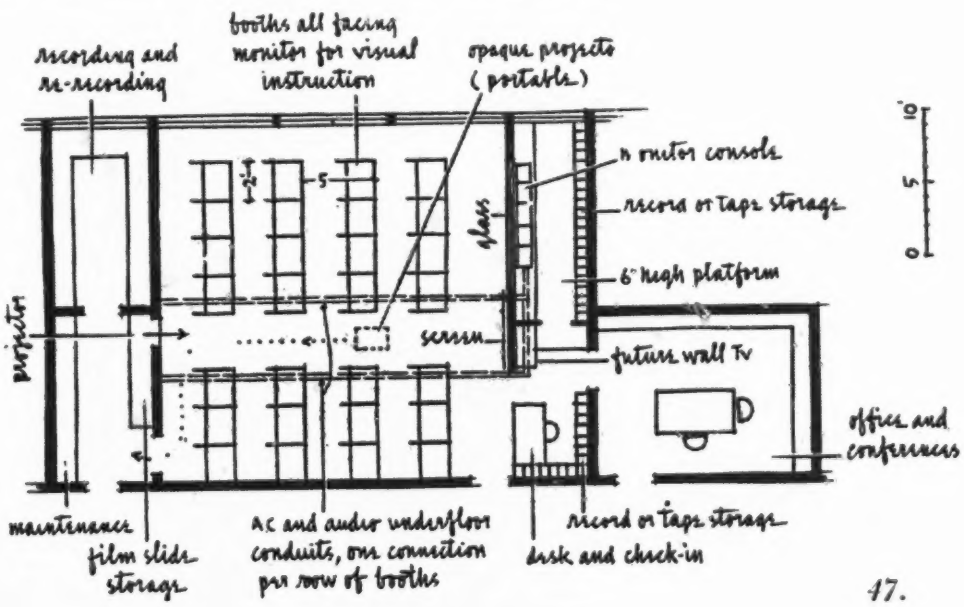
15.

b. *Science* — Here the trend is definitely established toward a more individualized program of "discovery" and away from the multiple performance of standardized experiments simultaneously by groups of pupils. This requires more variety of facilities, but provides for more efficient use, as well as improved learning.



46.

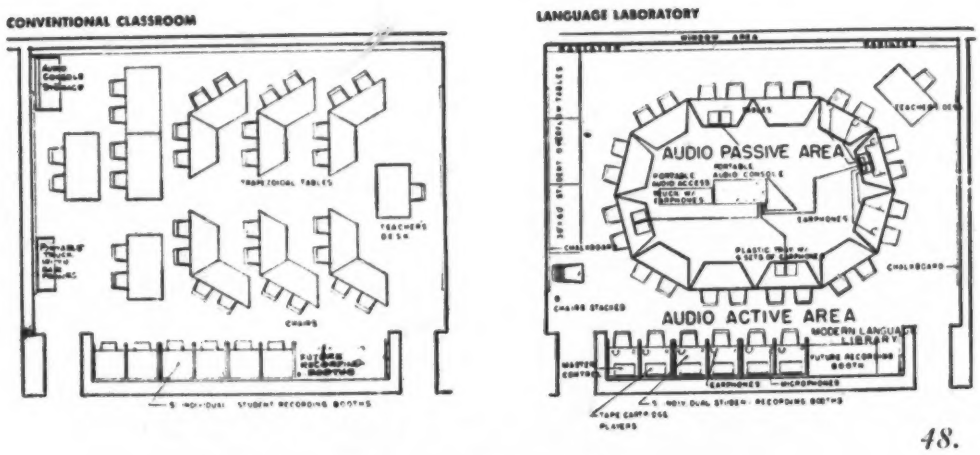
c. *Languages* — The major change in this field is a shift in emphasis from reading and grammar toward a ready speaking acquaintance, through the utilization of recently developed electronic and visual aids and their accompanying techniques. A completely specialized laboratory for this work might have the following layout.



47.

(Complete facilities - 28 student positions) LANGUAGE LABS

On the other hand, with the possibility of further technical advances in this field, there may be danger of freezing facilities into a pattern soon outmoded. For those who might wish to retain more flexibility for change in the language area, a convertible space with movable equipment has been suggested along the following lines.



48.

5. *Use of Teachers' Aides, Internes, Clerks*

One aspect of the daily life of the average teacher is a surprising amount of time spent performing non-teaching tasks. These include school bank accounting, roll-taking, routine paper-correcting, "personal maid" services to small children, filling out various forms, routine testing, supervision of various activities and many other actions hardly requiring the specialized skills of a well trained and experienced teacher.

To improve the use of these skills, many school systems are providing highly-qualified teachers with assistants to perform some of these less demanding tasks. Such assistants include:

a. *Internes* – These might also be called "apprentice teachers". They are usually students in teacher-preparation institutions who still lack sufficient practical experience. The advantages to the master teacher are clear. He is relieved of much routine work so that he may better prepare for future classes and devote more time to the individual pupils and their problems. At the same time the intern has the benefit of almost constant guidance from an experienced master of his future profession.

b. *Aides* – Teachers' aides are usually thought of as non-teaching assistants who absorb supervisory tasks, "maid-service" work, routine paper-correcting jobs and record-keeping.

c. *Clerks* – Clerical assistants are ordinarily intended to relieve the teacher of record-keeping, accounting and similar tasks requiring little knowledge of teaching methods.

The degree to which an individual school plant or system will make use of such personnel will dictate the need for modifications in a design. However, each design deserves thorough investigation of the possibilities inherent in the adoption of any of these schemes.

6. *Team Teaching*

This concept, in the main a post-war development, revolves around these basic ideas:

a. A standardized class size is not necessarily best for all types of

learning. Some items are very well presented through lecture by an expert, either in person or through the use of films or television. Other material is best studied in smaller seminar groups. Some activities are best pursued individually.

b. By the infinite variety of human nature, some teachers are more effective in small group situations, some in large presentations. Likewise, each is likely to develop specialized interests and skills in specific areas. All pupils should share in the benefits of these specialties, not just one particular group each school year.

c. A group of teachers, working together as a team will be able to plan and present a well-coordinated and vastly more effective educational program in the basic subjects, something hardly possible with separate teachers for each subject, in the independent departments of the conventional secondary school.

The ramifications of this concept are too many to discuss within the confines of this publicaton; likewise the possible implications for school building design are extremely various. However, these generalizations regarding designs for team teaching may safely be made:

—A variety in sizes of pupil groups must be provided for, ranging from individual study compartments to relatively large lecture-room situations.

—Resource centers should be provided for ready access to a great variety of teaching devices, demonstration and experimental equipment, as well as reference books and generalized working space.

—Facilities are needed where the teaching team may meet for planning, with adequate workspace for the preparation of demonstrations, teaching aids and associated materials. Suitable space for the guidance of student individuals and small groups is also desirable.

7. *Technological Tools*

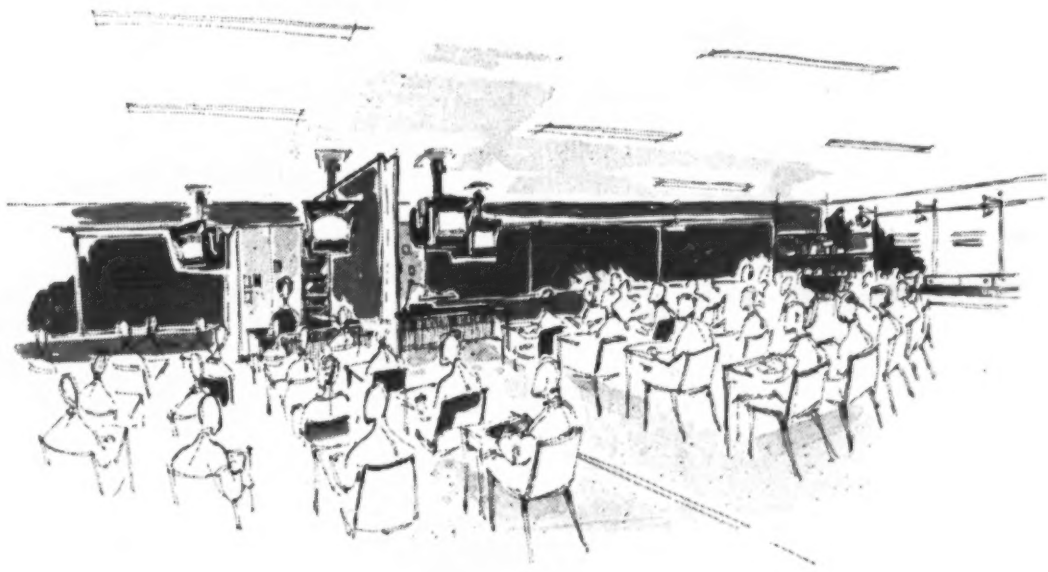
The world-wide technological speedup is making its impact felt in the educational systems of today with increasing effect. Some of the developments are:

a. *Educational Television* — Talked of for many years and balked because of financial problems and inertia, educational television is gradually taking shape at various points in our country. With its remarkable potential, educational television should be carefully investigated by every school board and building committee. The primary advantages of ETV in public schools lie in these areas:

1. The provision to great numbers of students of highly specialized presentations by uniquely qualified instructors. This aspect seems to be especially pertinent in sparsely settled areas, although of great value in large cities as well.

2. By the use of video-tape libraries, the provision of "preserved" presentation on scheduled demand anywhere in a school or system is practical. This should be compared with the present use of sound films, which require movement and limited use of both materials and equipment.

Experience with ETV is too limited as yet for precise cost estimation. At current prices, it seems likely that a fairly complete installation in a school for 500-800 pupils might cost somewhere near the price of an additional classroom. On the other hand, indications of the general adoption of ETV are so strong that no school should be designed without arrangements being made for its easy and economical installation later, if it is not to be a part of the initial project. As a minimum this would mean an empty conduit and box system or the provision of a concealed but readily accessible space for its later installation.



group viewing Televised Lesson 49.

b. *Tape and Disc Recordings* — These tools are already in extensive use in our public schools, but their utility is constantly increasing with the discovery of new applications and techniques.

1. Disc recordings are confined largely to materials for music, language and social studies, and ordinarily are mass-produced commercially.

2. Tape recordings, on the other hand, are highly flexible in use. They may be produced locally, recording anything audible and have a great variety of uses, particularly in the field of languages. The specialized uses for language teaching deserve careful study of the way in which they may be used, for these will often have a great deal of bearing on the design of the areas affected.

c. *Films, Slides and Other Visuals* — The use of these instructional aids is much more firmly established than the others, but new uses and methods of application are frequently being discovered. The principal implications for school plant planning involve provisions for room-darkening at the "point of use" and facilities for the preparation, cataloguing, housing and efficient distribution of such materials for optimum utilization. In any case, consideration should be given as to whether these activities are best carried out as a part of the school's main library, or as a separated facility located primarily for the ready access of all the teaching staff with no library supervision.

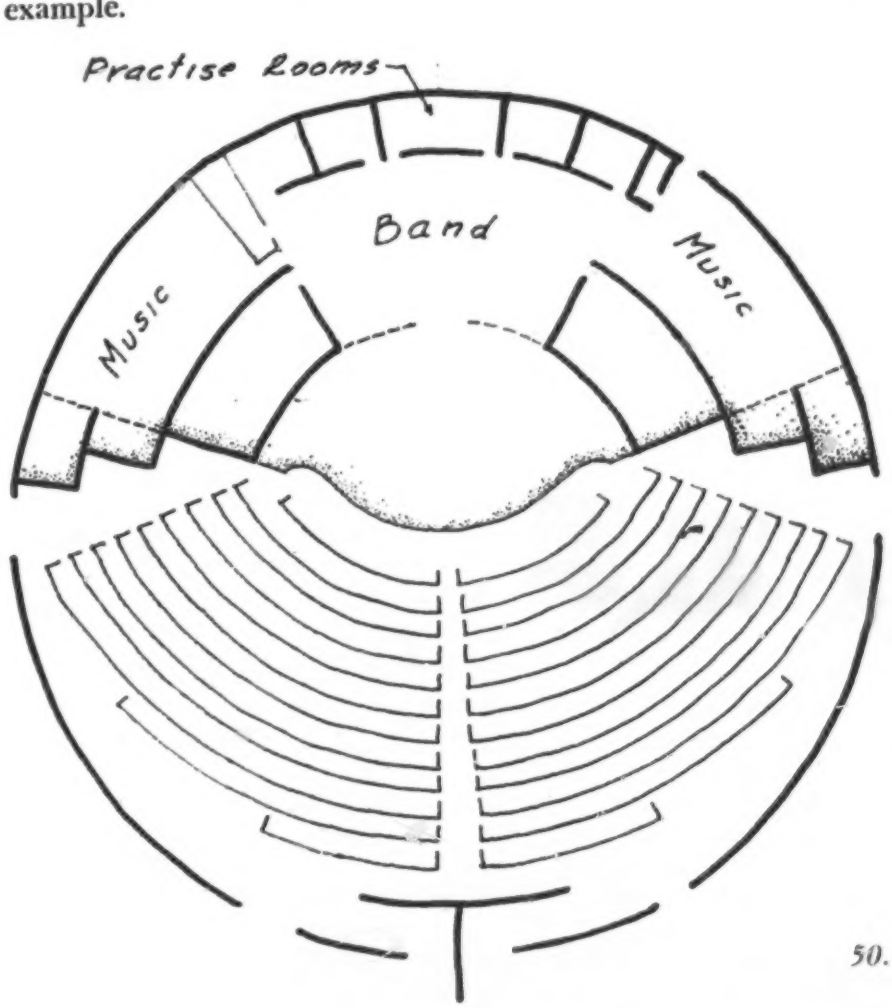
d. *Teaching Machines* – These devices, now undergoing rapid development, may well cause radical changes in the operation of school programs and in the needs for building function. Their cost, uncertain now, seems bound to drop as they become perfected and mass production techniques are applied to their manufacture. Any forward-looking building program should take them into consideration as plans are being formulated.

8. *Auditorium Facilities*

Changes are increasingly apparent in the provisions being made for auditorium functions.

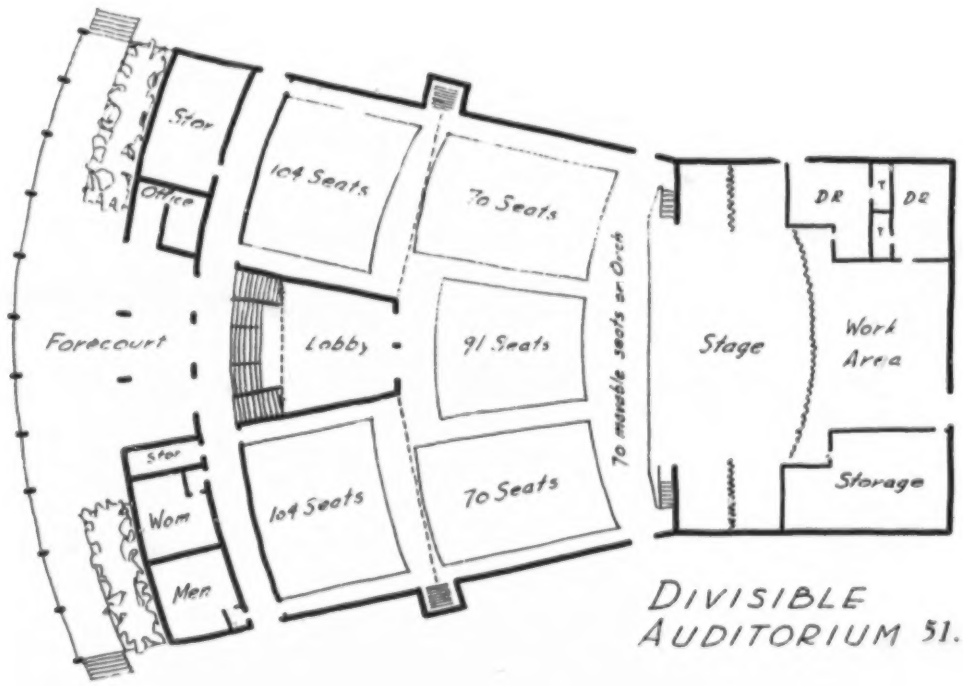
Traditionally, the auditorium has been a rectangular box for the audience, with a sort of picture-window opening at one end where the action to be observed takes place. This has given rise to technical problems in acoustics, lighting and scene-shifting, with more and more complicated and expensive attempts to solve them satisfactorily.

Now there is emerging a strong trend toward simplification and closer performer-audience contact. Various forms and adaptations of "theatre-in-the-round" are being developed for public school uses, with resultant simplicity, flexibility in use, and often, increased economy. Following is one example.



50.

Many auditoriums are being designed to be variable in size, sometimes with convertibility to other uses, especially as a lecture-hall, as in the following example.



DIVISIBLE AUDITORIUM 51.

9. *Expanding Library Services*

The school library remains the major source of supplemental materials to serve all phases of the instructional program. Probably the most dramatic change in this field is being brought about by the extension of library services to areas such as science and mathematics, where local branch library facilities are provided in conjunction with the specialized programs involved.

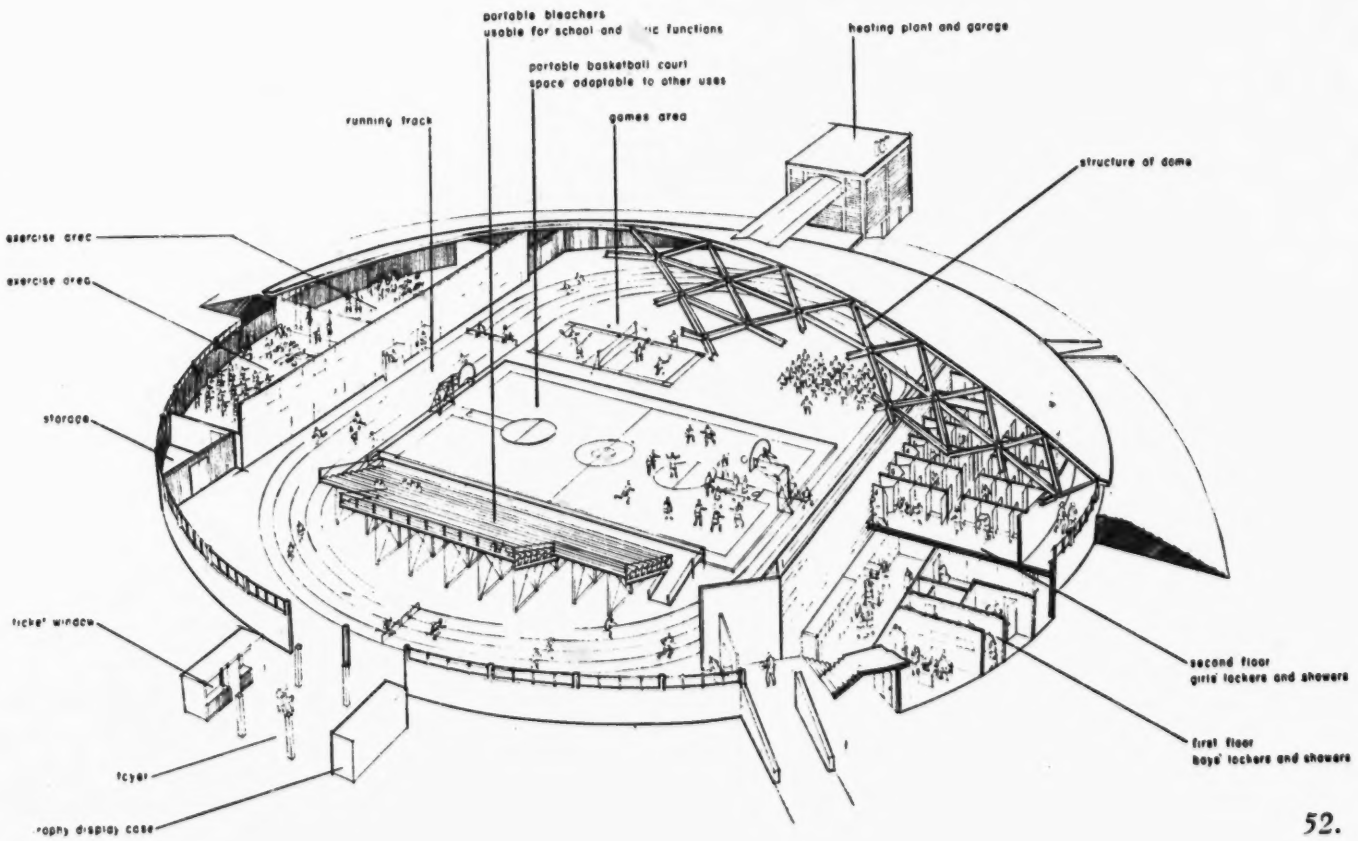
These extensions of the library service may be called "resource areas" for the specialized area of instruction or team teaching area being served and provide for the immediate and extended availability of supplemental materials needed.

The central library continues to perform its normal functions, but with the added tasks shared with the special-area instructional staffs, of keeping the resource areas constantly supplied with up-to-date materials appropriate to the current context of the course program.

10. *Physical Education Facilities*

The trend evident in physical education is away from specialization and school team emphasis and toward variety and all-around physical development of each individual to the best of his capabilities.

One evidence of this trend is in a number of physical education plants which might well carry the name "field house" rather than "gymnasium". Typically, they provide a large area under roof with earth floor. In such a space, a variety of activities can take place simultaneously, and the space becomes very flexible for use in many different ways, yet is entirely compatible with conventional activities, as in the following example:


portable bleachers
usable for school and ...ic functions
portable basketball court
space adaptable to other uses
heating plant and garage
running track
games area
structure of dome
exercise area
exercise area
storage
ticket window
foyer
trophy display case
second floor
girls' lockers and showers
first floor
boys' lockers and showers

52.

53

C. DECISION MAKING

Making up one's mind (not to mention that of a committee) about such uncertain matters as are discussed above is not easy. Decisions on future possibilities seldom are easy. Nonetheless, decisions must be made. It must be determined what to plan on and what to do about it. Happily, no one person must do it all alone. These problems are best dealt with in three steps:

1. *Educational Policy*

First of all, the kind of educational program to be carried out must be established by the local board of education, with the assistance of the professional educators on the staff. This should include serious consideration of the developments on the educational horizon, with judgements made as to what should be adopted and when.

2. *Policy Implications*

Having determined objectives, it will be necessary for the board and its staff to decide what methods and facilities wll be necessary to carry them out. And in all justice to those who follow them, it will be necessary to include their best judgement as to what the future educational scene will be like and what needs it will bring with it. All these immediate and anticipated needs should be clearly organized and set down in the "educational specifications" for the proposed plant.

3. *Building Design*

Here we come to the area of the building committee's responsibility, together with that of their architect. To this group, conferring frequently with the board of education and staff, falls the responsibility for developing a design which will provide logically for all the present needs and make easy the way for those expected to develop in the future.

This is not an easy task, but it is a great challenge. Those who rise to it merit the gratitude of their townspeople for many years to come.

4. *Long-range Economy*

Architects and committee members are advised to stop and check their decisions frequently, as to materials, mechanical systems and controls and possible additions to assure that zeal for initial low cost does not lead to high operating and maintenance costs. True cost will always be the total of initial cost, operating costs, plus maintenance and repair expenses over the entire term of use.

CHAPTER X
STATE AND LOCAL CODES

In the basic layout of school buildings it is necessary to "design in" compliance with various legal requirements, including the following:

A. GENERAL STATUTES

1. Schoolhouses; construction	Sec. 19-380
2. Fastening of doors	Sec. 19-381
3. Fire alarms	Sec. 19-382
4. Penalties	Sec. 19-383
5. Stairways and Fire Escapes for Schoolhouses	Sec. 19-384a
6. Condemnation of Nonconforming building	Sec. 19-385a
7. Stairways and Fire Escapes in Certain Buildings	Sec. 19-386

B. STATE FIRE SAFETY CODE

1. General Provisions	Sec. 172-1- 1 thru 7
2. New School, Extensions, Conversions	Sec. 172-1-135 thru 154
3. Existing School Buildings	Sec. 172-1-155 thru 175
4. Places of Assembly	Sec. 172-1- 8 thru 25
5. Outside Stairways	Sec. 172-1- 43 thru 56
6. Heating and Cooking Facilities	Sec. 172-1- 57 thru 67
7. Oil Burning Equipment	Sec. 172-6- 1 thru 51
8. Storage, Use (etc.) of flammable liquids	Sec. 172-2- 1 thru 129
9. Storage, Use (etc.) of liquified petroleum Gas	Sec. 172-5- 1 thru 134

(Submission of final drawings and specifications to the State Department of Education for review in accordance with the above is required by Section 10-292 of the General Statutes.)

C. STATE SANITARY CODE

1. Sewage Disposal Systems	Reg. 103
2. Swimming Pools and Bathing Places	Reg. 113, 117
3. Garbage and Refuse	Reg. 104

4.	Schoolhouses	Reg. 110
5.	Towels in Public Places	Reg. 115
6.	Drinking Cups and Drinking Fountains	Reg. 116
7.	Cross-connections, water supply	Reg. 118
8.	Quality of Water	Reg. 120
9.	Sanitation of Foodstuffs	Reg. 121
10.	Places Dispensing Food or Beverages	Reg. 123
11.	Plumbing and Drainage Systems	Reg. 127

Where no municipal sewerage is available, *formal approval* of the State Department of Health must be applied for on a prescribed form and received on drawings and specifications for sewage disposal system. Upon request of a local official, State Department of Health personnel will conduct soil tests to determine the suitability of sites under consideration as regards sewage disposal.

Submission of final drawings and specifications to the State Department of Education for reviewing compliance with the State Sanitary Code is required by Section 10-292 of the General Statutes.

D. ELEVATORS AND ESCALATORS (including dumbwaiters)

Plans for these must be approved by the State Labor Department before construction shall begin, as required by Section 19-412 of the General Statutes.

E. LOCAL CODES

Building Committees and their architects should ascertain whether the municipality has adopted the State Building Code or has any other applicable building code, and if so, be responsible for compliance with all its provisions. Violations, even though unintentional, can be very costly indeed to correct ofter construction.

F. LOCAL FIRE MARSHAL

Commonly no formal plan review procedure exists, especially in the smaller municipalities. However, a review of the scheme during the planning stages with the local fire marshal will often avoid awkward and expensive differences of opinion subsequent to construction, when changes are much more difficult to make.

In general, all code requirements and approval procedures should be followed with scrupulous care. Lack of care in this regard has led, in many past instances, to wasteful delays and costly corrective measures. As a usual thing, such difficulties can largely be eliminated at little or no cost when dealt with during the planning stages.

REFERENCES

1. *Schools*—L. B. Perkins and W. D. Cocking. 264 pp. Reinhold Publishing Corporation. 1949.
2. *Schools for the Very Young* — H. H. Waechter and E. Waechter, 197 pp. F. W. Dodge Corporation, 1951.
3. "Some considerations in the Natural Ventilation of Buildings" — Research Report No. 22, Texas Experiment Station, College Station, Texas 1951.
4. "Cutting Costs in Schoolhouse Construction" — American Association of School Administrators. 19 pp. AASA, 1952.
5. *Planning Elementary School Buildings* — N. L. Englehardt, N. L. Englehardt, Jr., and S. Leggett. 268 pp., F W. Dodge Corporation, 1953.
6. *Flexible Classrooms* — R. E. Wilson. 64 pp. Carter Publishing Corporation, 1953.
7. *Toward Better School Design* — W. W. Caudhill. 261 pp. F. W. Dodge Corporation, 1954.
8. *Schools for the New Needs* — Architectural Record. 312 pp. F. W. Dodge Corporation, 1956.
9. *School Planning and Building Handbook* — N. L. Englehardt, N. L. Englehardt, Jr., and S. Leggett. 626 pp. F. W. Dodge Corporation, 1956.
10. *The Secondary School Plant* — U. S. Office of Education. 60 pp. U. S. Government Printing Office, 1956.
11. *Secondary School Plant Planning* — National Council on Schoolhouse Construction. 83 pp. NCSC, 1957.
12. *High Schools of Today and Tomorrow* — C. W. Bursch and J. L. Reid. 127 pp. F. W. Dodge Corporation, 1957.
13. *Modular Construction* — Special Issue, PROGRESSIVE ARCHITECTURE, November, 1957.
14. *Guide to Planning School Plants* — National Council of Schoolhouse Construction, 254 pp., NCSC, 1958.
15. "Potential Economies in Schol Building Construction" — School of Architecture, R. P. I. 51 pp. New York State Department of Education, 1958.
16. *Schoolhouse* — W. McQuade — 271 pp. Simon and Shuster, 1958.
17. *Purchase Guide for Programs in Science, Mathematics, Modern Foreign Languages* — Council of Chief State School Officers and EFL 336 pp. Ginn and Company, 1959.
18. *Saving Dollars in Building Schools* — D. A. Pierce. 112 pp., Reinhold Publishing Company, 1959.
19. "Images of the Future — A New Approach to the Secondary School" — J. L. Trump 46 pp. National Education Association, 1959.
20. *Th Cost of a Schoolhouse* — Educational Facilities Laboratories. 144 pp. 1960.
21. *Planning America's School Buildings* — AASA School Building Commission. 229 pp. American Association of School Administrators. 1960.
22. "Planning for Schools with Television" — D. Chapman, Incorporated, 96 pp. Educational Facilities Laboratories, 1960.
23. "A Review of Studies of Economies in Schoolhouse Construction" — L. D. Doherty and A. Wheatley. 27 pp. New York State Department of Education, 1960.
24. *Economic Planning for Better Schools* — B. Handler. 107 pp. University of Michigan, 1960.

25. "New Schools for New Education" — Educational Facilities Laboratories. 52 pp. Educational Facilities Laboratories, 1960.

26. "School Fires — An Approach to Life Safety" — Building Research Advisory Board and Committee on Fire Research. 58 pp. National Academy of Sciences — National Research Council, 1960.

27. "Schools for Team Teaching" — E. Clinchy. 64 pp. Educational Facilities Laboratories, 1961.

28. "A Few Hard Facts about Design: Cost: Construction of the Modern School Building" —26 pp. The Allied Masonry Council, 1961.

29. "The School Building Economy Series" — Connecticut State Department of Education:

    #1—"School Building Project Procedures"—37 pp., 1960.

    #2—"Educational Specifications"—Scheduled for 1961.

    #3—"School Sites—Selection and Acquisition"—12 pp., 1960.

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Fig. 5—Ketchum and Sharp, Architects

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Fig. 15—Louis J. Drakos, Architect

Fig. 16—The Malmfeldt Associates, Architects

Fig. 17—William F. R. Ballard, Architect

Fig. 18—Ketchum, Gina and Sharp, Architects

Fig. 19—Warren H. Ashley, Architect

Fig. 20—The Malmfeldt Associates, Architects

Fig. 24—Texas Engineering Experiment Station

Fig. 30—Nichols and Butterfield, Architects

Fig. 32—The Malmfeldt Associates, Architects

Fig. 33—Sherwood, Mills and Smith, Architects

Fig. 35—Nichols and Butterfield, Architects

Fig. 36—The Malmfeldt Associates, Architects

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Fig. 42—Gilroy and Gaydosh, Architects

Fig. 43—Nichols and Butterfield, Carl Segerberg, Assoc. Architects

Fig. 44—McLeod and Ferrara, Architects

Fig. 47—PROGRESSIVE ARCHITECTURE magazine

Fig. 48—SCHOOL MANAGEMENT magazine

Fig. 49—Dave Chapman, Incorporated and Educational Facilities Laboratories

Fig. 52—The Architects Collaborative, Architects